Code for Offshore Personnel Transfer Systems

July 2022

A guide to the Rules

and published requirements

Code for Offshore Lifting Personnel Systems

Introduction

These Rules are published as a complete set.

Rules updating

These Rules are published and changed through a system of Notices between releases.

July 2022

CHAPTER 1 OFFSHORE PERSONNEL TRANSFER SYSTEMS

SECTION 1 GENERAL

SECTION 2 OFFSHORE PERSONNEL TRANSFER SYSTEM TYPES

SECTION 3 LOADS AND FACTORS

SECTION 4 LOAD CASES AND LOAD COMBINATIONS

SECTION 5 ALLOWABLE STRESSES AND SAFETY FACTORS

SECTION 6 FITTINGS, LOOSE GEAR AND ROPES

SECTION 7 MACHINERY

SECTION 8 FUNCTIONAL REQUIREMENTS

SECTION 9 ELECTROTECHNICAL SYSTEMS

SECTION 10 RISK ASSESSMENT

SECTION 11 QUALITY ASSURANCE SYSTEM

SECTION 12 MATERIALS AND FABRICATION

SECTION 13 TESTING, MARKING AND SURVEYS

SECTION 14 DOCUMENTATION

CHAPTER 2 ANNEX RECOMMENDATIONS FOR SAFE OPERATION OF THE OPTS

Section
1 **General**
2 **Offshore Personnel Transfer System types**
3 **Loads and factors**
4 **Load cases and load combinations**
5 **Allowable stresses and safety factors**
6 **Fittings, loose gear and ropes**
7 **Machinery**
8 **Functional requirements**
9 **Electrotechnical systems**
10 **Risk assessment**
11 **Quality assurance system**
12 **Materials and fabrication**
13 **Testing, marking and surveys**
14 **Documentation**

Section 1
General

1.1 Introduction

1.1.1 This document defines technical requirements for the certification and classification (*see Ch 1, 1.6 Classification procedure* and *Ch 1, 1.7 Certification procedure*) of Offshore Personnel Transfer Systems (OPTS). The OPTS shall be designed, manufactured and installed in accordance with the requirements of this Code.

1.1.2 This Code is intended to support and complement the applicable parts of the current *Code for Lifting Appliances in a Marine Environment, July 2022* in areas where specific conditions (related to the environment, loads, design, etc.) of an OPTS are required to be taken into account.

1.1.3 A typical arrangement of an OPTS is shown in *Figure 1.1.1 Typical arrangement and components of an OPTS* and the typical parts of an OPTS consist of:

(a) pedestal or foundation (not part of the mothership structure);
(b) motion compensation system (optional);
(c) base frame;
(d) machinery housing (may not necessarily be mounted on the base frame);
(e) Operator station (ideally placed close to the gangway);
(f) gangway, main part;
(g) gangway, telescopic part (usually installed but may also be optional); and
(h) landing or connecting arrangement.

Other possible arrangements and layouts of an OPTS may not use all of the shown parts and/or may use other components and arrangements.

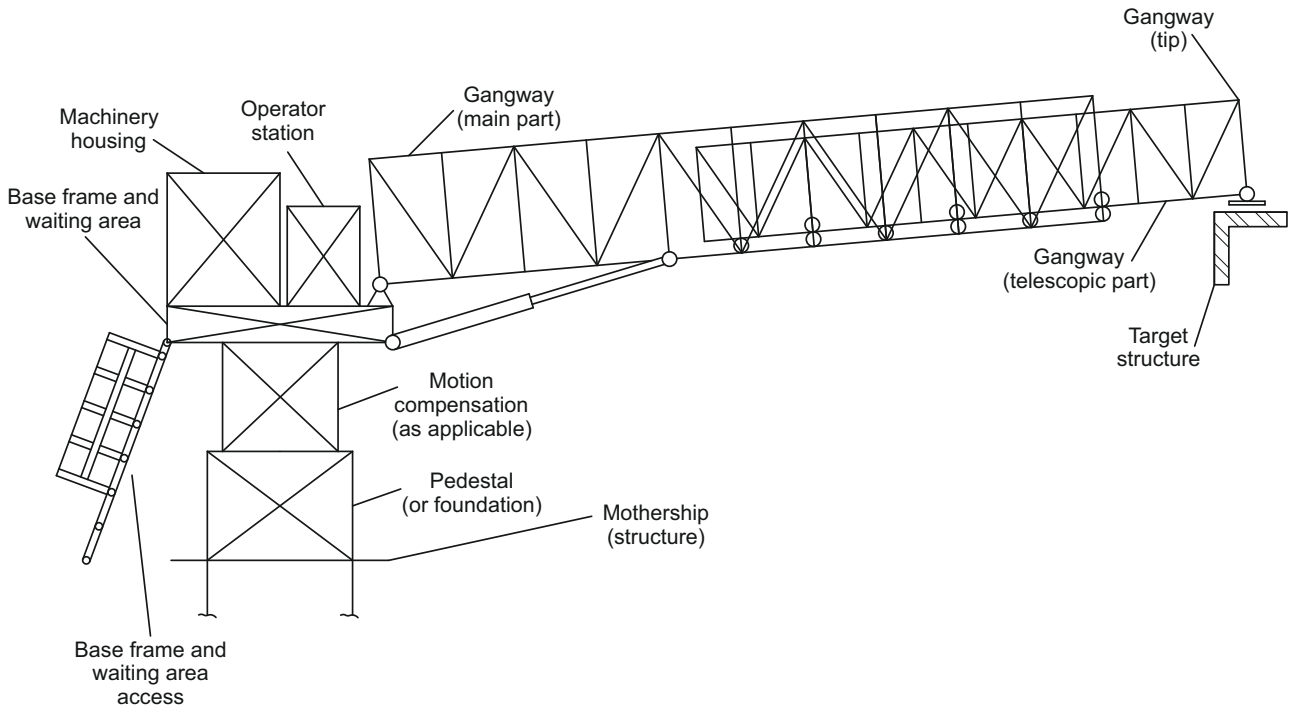

Figure 1.1.1 Typical arrangement and components of an OPTS

1.1.4 The operational and functional sequence of a typical motion compensated OPTS as shown in *Figure 1.1.1 Typical arrangement and components of an OPTS* may be described as outlined in *Table 1.1.1 Operational and functional sequence of a typical motion compensated OPTS*.

Table 1.1.1 Operational and functional sequence of a typical motion compensated OPTS

Operational step	Service condition	Persons on gangway	Functional/operational description
1	Out-of-service	No	The OPTS is securely stowed on deck of the mothership.
2	Out-of-service	No	The Operator prepares the OPTS for service (e.g. release of stowage arrangements) and takes position at the Operator station.
3	In-service	Possible	Personnel are boarding the waiting area on the OPTS (directly or via the gangway).
4	In-service	No	The OPTS is powered up.
5	In-service	No	The base frame and the gangway are lifted up from their resting positions and the OPTS is slewing to the off-board position.

6	In-service	No	The motion compensation system (and the base frame) is taken to its neutral position (usually in between maximum positions).
7	In-service	No	The motion compensation system is activated.
8	In-service	No	The gangway will be luffed up or down to adjust for a potential height difference between the waiting area on the base frame and the target structure.
9	In-service	No	The telescopic part of the gangway will be extended towards the target structure on the target unit.
10	In-service	No	The gangway landing/connection arrangement: • may land on; • may be pushed against; • may be structurally secured to; the target structure to enable a safe transfer of personnel.
11	In-service	No	The system may be switched into a lower level of motion compensation where slewing and/or telescoping and/or luffing are partly and passively compensating mothership motions without external power supply.
12	In-service	Yes	The system is in active or passive compensation mode and personnel may access the gangway and transfer to the target unit, if allowed by the Operator.
13	In-service	No	The system regains full motion compensation and slewing and/or telescoping and/or luffing are back to powered compensation.
14	In-service	No	The gangway landing/connection arrangement is disconnected from target structure by telescoping in.
15	In-service	No	The motion compensation system (and the base frame) is taken to its neutral position (*see* operational step 6).
16	In-service	No	The base frame and the gangway are lowered to their resting positions.

17	In-service	Possible	The transferring personnel is leaving the OPTS via the waiting area or via the gangway.
18	Out-of-service	No	The OPTS is powered down.
19	Out-of-service	No	The Operator secures the OPTS on the mothership deck in its stowage position.

1.1.5 In certain circumstances the requirements of this Code may not adequately cover the actual project, e.g. due to novel design or other reasons. In such circumstances, the applicability of this Code may require further consideration in which case it is recommended to contact LR at an early stage in order to discuss and agree the specific technical requirements and the certification or classification approach. In all circumstances, however, a specific risk assessment as defined in *Ch 1, 10 Risk assessment* will be required.

1.1.6 In general, the lifting and supporting of persons with lifting appliances in an offshore or open sea environment is regarded as an activity posing higher risks for personnel compared to normal cargo handling operations. The requirements in this document are intended to mitigate such elevated risks.

1.2 Scope

1.2.1 This Code covers the design, fabrication, survey and documentation requirements for an OPTS. However, it should be noted that the requirements of *Ch 1 General*, *Ch 4 Cranes and Submersible Lifting Appliances*, *Ch 8 Fittings, Loose Gear and Ropes*, *Ch 9 Machinery*, *Ch 10 Electrotechnical Systems*, *Ch 11 Materials and Fabrication*, *Ch 12 Testing, Marking and Surveys* and *Ch 13 Documentation* of the *Code for Lifting Appliances in a Marine Environment, July 2022* also apply (as applicable) except in such instances where the specific requirements are otherwise defined in this Code.

1.2.2 OPTS for the purposes of these requirements cover the following systems:

(a) Systems installed on motherships providing safe passage to fixed installations in open sea conditions by means of passive, active or hybrid compensation systems (e.g. mothership to fixed wind energy offshore structures). These three systems are defined in *Ch 1, 2 Offshore Personnel Transfer System types*.

(b) Systems installed on motherships providing safe passage to other ships or offshore units or floating installations in open sea conditions by means of passive, active or hybrid compensation systems (e.g. mothership to ship transfer).

(c) Systems which are 'bridging' two floating structures in open sea conditions (e.g. bridging of a 'Flotel' and an FPSO) usually by means of passive compensation systems.

(d) Systems which fulfil a dual function of providing safe transfer between installations and/or ships and/or offshore units in open sea conditions and also providing cargo handling capabilities.

(e) Systems without a gangway but equipped with a personnel containment such as a basket or other type of carrier which contains or supports personnel for the purposes of transfer from the mothership to the target unit (e.g. from mothership to fixed wind energy offshore structures).

(f) Systems not described in the above will be specially considered on the basis of this Code and the *Code for Lifting Appliances in a Marine Environment, July 2022*. *See Ch 1, 1.1 Introduction*.

1.2.3 The scope of this Code with respect to certification and classification of the OPTS does not extend to:

(a) any aspects related to the operation of the OPTS;

(b) systems operating at an ambient air temperature below -50°C;

(c) systems operating at an ambient air temperature above +45°C;

(d) systems designed for minimum design temperatures below -40°C (*see Ch 4, 2.25 Materials 2.25.3* of the *Code for Lifting Appliances in a Marine Environment, July 2022*);

(e) gangway construction materials other than steel;

(f) systems with the gangway at an inclination of more than 20 degrees (with personnel on the gangway);

(g) ship to shore gangways and linkspans;

(h) structure of the mothership in way of the pedestal/foundation;

(i) lifting, handling and erection of the OPTS or their components;

(j) transport of an OPTS and/or its components;

(k) accidental collision loads, e.g. collision of the OPTS with a structure or an object, etc.;

(l) explosion/blast loads;
(m) assembling or disassembling of the OPTS and/or its components;
(n) scrapping or disabling of the OPTS and/or its components;
(o) handling of loads (e.g. cargo) using the (optional) dedicated crane functionality simultaneous with the transfer operation of personnel;
(p) an OPTS being installed on naval vessels where the mothership and/or target unit are moving during transfer; and
(q) any misuse.

1.2.4 Where an OPTS also serves as a conventional offshore crane in addition to its personnel transfer functionality then the OPTS shall be designed in accordance with the applicable requirements of the *Code for Lifting Appliances in a Marine Environment, July 2022* in addition to the requirements given in this Code. In case of any conflict the more onerous requirement shall prevail. It is recommended that LR is contacted at an early stage in order to agree on a resolution of such issues.

1.2.5 In order for this Code to be applicable it is required that the ships and/or floating units and/or offshore units are moored or a Dynamic Positioning System or a Positional Mooring System is installed on the mothership supporting the OPTS or which is served by the OPTS. The capability and performance of the position keeping system and its reference systems are to be taken into account and are to ensure safe operation of the OPTS in all environmental conditions for which the personnel transfer system is designed. The requirement for the installation of position keeping systems will be specially considered in case of small vessels or other circumstances (e.g. low operational significant waves heights) where such systems may be unreasonable or may not be applicable.

1.2.6 The OPTS is to be designed considering the individual characteristics of the mothership. Such individual characteristics can be related to mothership motions, mothership inclination, station keeping performance, etc. If the mothership is unknown at the time of design, a design load envelope shall be defined which includes design accelerations, inclinations and other loads and limiting parameters.

1.2.7 In case of a non-permanently installed OPTS, the design is to make reference to a design envelope taking into account the maximum governing loads required to be applied for the design of the OPTS. Any operational parameters and safety requirements or any limitations as a result of the design of OPTS are to be taken into consideration. It is to be ensured the aforementioned loads, requirements, parameters and limitations of the actual OPTS are not exceeded when installing and operating the OPTS on the actual temporary mothership.

1.3 Stakeholders

1.3.1 This Code is considered relevant to the following stakeholders:

(a) National and/or Coastal State Authorities.
(b) Owners and/or Operators of units and ships on which OPTS are installed.
(c) Designers/manufacturers responsible for the design, production and installation of OPTS.
(d) Lloyd's Register plan appraisal Specialists.
(e) Lloyd's Register site Surveyors.

1.4 Prerequisites

1.4.1 OPTS built in accordance with the requirements of this Code will be classed or certified and will continue to be classed and certified as long as they are found, upon examination at the prescribed surveys, to be maintained in accordance with the requirements of the Code.

1.4.2 These requirements are framed on the understanding that:

(a) The OPTS and/or associated components and/or equipment will at all times be properly operated and loaded in accordance with the designer's or manufacturer's instructions and the loading conditions approved by LR.
(b) Where the OPTS and/or associated components and/or equipment is to be certified but not classed, the design criteria specified conclude that Periodical Survey procedures, at least equivalent to LR's, will be adhered to by the Owner or the OPTS Operator.
(c) The OPTS and/or associated components and/or equipment will at all times be properly operated by authorised personnel who are sufficiently competent, trained and qualified.
(d) The OPTS and/or associated components and/or equipment will be maintained by authorised personnel who are sufficiently competent, trained and qualified.

(e) The OPTS installed on the mothership will not be operated in environmental conditions more severe than those agreed for the design basis and approval and shall not be subjected to marine operational conditions that exceed the parameters used in design and established according to this Code.

(f) Before performing a personnel transfer operation, the Operator will ensure that the actual mothership (and target unit) motion parameters at current sea state, the current wind speed, the actual elevation gap between mothership and target unit and the required range of the telescoping system and other relevant parameters, do not exceed the limiting values as defined by the individual design and specified in the instructions for use. Marine and offshore contractors and the Operator responsible for personnel transfer operations will be informed of these limitations and the necessary restrictions during the personnel transfer operations will be put in place.

(g) The OPTS and/or associated components and/or equipment and surroundings will be thoroughly inspected by the Operator prior to use as required by the instructions for use.

(h) The manufacturer is to have a documented quality assurance system in place (including a continuous improvement system) in compliance with a recognised National or International Standard, e.g. ISO 9001 *Quality management systems – Requirements*. For further details *see Ch 1, 11 Quality assurance system*.

(i) Compliance with these requirements does not absolve the designers and/or manufacturers of their contractual responsibilities to the Owner/Operator for compliance with the specification and the overall design and in-service performance of the OPTS and/or associated components and/or equipment.

(j) It is the responsibility of the Operator or Owner to ensure that the OPTS is safely operated in compliance with the instructions for use issued by the designer/manufacturer.

1.5 Authority requirements

1.5.1 The responsible National Authority (i.e. Flag State) and/or Coastal State and/or other regulatory authorities responsible for the offshore sector in which the OPTS is intended to be operated may have additional requirements which need to be adhered to as applicable in addition to these requirements.

1.5.2 In case of conflict with this Code, the requirements of the National Authority and/or Coastal State and/or other regulatory authorities take precedence.

1.6 Classification procedure

1.6.1 The classification of the OPTS is required in case the system is forming an essential feature of the mothership. *See Ch 1, 1.3 Classification 1.3.2* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

1.6.2 The classification of the OPTS covers the design, construction, examination, testing and subsequent Periodical Surveys to the extent indicated within this Code and is achieved by way of the engagement of LR Surveyors at the appropriate stages of design, construction, installation, commissioning, and periodical examinations during service. The following activities are undertaken by LR:

(a) Appraisal of plans covering structural, mechanical, hydraulic, electrical and control engineering aspects of the OPTS.

(b) Verification that the material for structural components and machinery items adopted for a classed OPTS complies with *Ch 1, 12 Materials and fabrication* of these requirements. The required documentation for the materials used is to comply with *Ch 1, 12 Materials and fabrication* and *Ch 1, 12.8 Documentation 12.8.2*.

(c) Survey during fabrication of the critical and primary structure and winches, hydraulic cylinders and other machinery, parts and components at the place of manufacture, including verifying that materials are in accordance with the approved plans and suitably qualified welders using approved weld procedures are employed in the fabrication. Further details are provided in *Ch 1, 12 Materials and fabrication*.

(d) Survey at the manufacturer to include the hydraulic, electrical and control engineering systems.

(e) Verification of certificates for the appropriate forms of wire ropes and chains which are to be manufactured at works approved by LR.

(f) Survey of the gangway and remaining critical and primary structure, winches, electrical, control and hydraulic systems during installation and on-site assembly.

(g) Survey and testing of the motion compensation, connection and disconnection systems and arrangements (as applicable).

(h) Survey during load and operational testing of the OPTS, as specified in *Ch 1, 13 Testing, marking and surveys*.

(i) Periodical Surveys and tests, as specified in *Ch 1, 13.9 Classification surveys*.

1.6.3 The standard procedure for classification is given in *Ch 1, 1.3 Classification 1.3.5* and *Table 13.3.1 Minimum requirements for the classification of lifting appliances* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

1.6.4 The classification of an existing OPTS or an OPTS which is not permanently installed on a specific unit or mothership will be specially considered.

1.7 Certification procedure

1.7.1 Where certification, which is distinct from classification, of the OPTS is requested, the procedures to be adopted are the same as those for classification outlined in *Ch 1, 1.6 Classification procedure*, with the following exceptions:

(a) The required documentation for the materials used may comply with *Ch 1, 12.8 Documentation 12.8.3*.

(b) A class notation will not be assigned to certified OPTS.

(c) Periodical Surveys after commissioning of the OPTS need not be carried out by LR. However, the Owner's/Operator's/designer's attention is drawn to *Ch 1, 13.5 Periodical thorough examinations* with respect to the need for ongoing Surveys.

1.7.2 The certification of an existing OPTS will be carried out following the procedure as given in *Ch 1, 13.4 Initial Survey of existing installations*. The certification of an OPTS which is not permanently installed on a specific unit or mothership will be specially considered.

1.8 Class notations

1.8.1 If the OPTS forms an essential feature of the mothership, the mandatory class notation **LA** shall be applied.

1.8.2 The special feature class notation which may optionally be applied to OPTS is defined as **W2W**.

1.9 Referenced Rules, Codes and Standards

1.9.1 The authority requirements and the requirements of Codes, Rules and Standards listed in the following are to be applied in the following order of priority:

(a) The requirements of the National and/or Coastal State Authorities and/or other regulatory authorities (responsible for the mothership and/or the offshore area of operation respectively).

(b) The requirements of this *Code for Offshore Personnel Transfer Systems*.

(c) The requirements of Lloyd's Register's *Code for Lifting Appliances in a Marine Environment, July 2022*.

(d) Other Lloyd's Register Rules and Standards (as applicable); and

(e) The list of ISO, EN and other standards (*see Ch 1, 1.9 Referenced Rules, Codes and Standards 1.9.5* and *Ch 1, 1.9 Referenced Rules, Codes and Standards 1.9.6*) provides a list of preferred standards in case requirements are considered necessary to be taken from such standards in the absence of requirements in (a), (b), (c) or (d) above. However, the application of such additional standards shall be agreed between the Owner and/or Operator, designer/manufacturer of the OPTS and LR as applicable and required for the individual project on a case-by-case basis.

The order of standards may also depend on the requirements of the National and/or Coastal State Authorities responsible for the ship and/or the offshore area of operation respectively. The selection of standards as defined in *Ch 1, 1.9 Referenced Rules, Codes and Standards 1.9.1.(e)* shall be agreed with LR prior to commencing of the project.

1.9.2 The edition or version of the Rules, Codes or standards shall be the one being in force on the contract date between the Owner/Operator and the yard building the mothership. Where designs and/or projects are not related to a specific mothership, the edition or version of the applicable Rules, Codes or Standards shall be the one being in force on the contract date between the designer/manufacturer and LR for certification of the OPTS.

1.9.3 If a recognised National or International Standard listed in the following has been withdrawn it shall no longer be used unless it has been replaced by another valid and recognised standard.

1.9.4 Lloyd's Register Rules, Codes and Procedures;

(a) *Code for Lifting Appliances in a Marine Environment, July 2022*,

(b) *Rules for the Manufacture, Testing and Certification of Materials, July 2022*,

(c) *Rules and Regulations for the Classification of Ships, July 2022*,

(d) *Rules and Regulations for the Classification of Offshore Units, July 2022*,

(e) *Rules for the Winterisation of Ships, July 2022*,

(f) ShipRight Procedure *Cyber Security for Ships and Ships Systems*,

(g) ShipRight Procedure *Risk Based Certification (RBC)*.

1.9.5 European standards:

(a) EN 614 *Safety of machinery – Ergonomic design principles*,

(b) EN 842 *Safety of machinery – Visual danger signals – General requirements, design and testing*,
(c) EN 1127-1 *Explosive atmospheres – Explosion prevention and protection – Part 1: Basic concepts and methodology*,
(d) EN 10204 *Metallic products – Types of inspection documents*,
(e) EN 12077-2 *Cranes safety – Requirements for health and safety – Part 2: Limiting and indicating devices*,
(f) EN 12385-1 *Steel wire ropes – Safety – Part 1: General requirements*,
(g) EN 12385-2 *Steel wire ropes – Safety – Part 2: Definitions, designation and classification*,
(h) EN 12385-3 *Steel wire ropes – Safety – Part 3: Information for use and maintenance*,
(i) EN 12385-4 *Steel wire ropes – Safety – Part 4: Stranded ropes for general lifting applications*,
(j) EN 12644-1 *Cranes – Information for use and testing – Part 1: Instructions*,
(k) EN 12644-2 *Cranes – Information for use and testing – Part 2: Marking*,
(l) EN 13001 *Cranes – General design*,
(m) EN 13135 *Cranes – Safety – Design – Requirements for equipment*,
(n) EN 13411-3 *Terminations for steel wire ropes – Safety – Part 3: Ferrules and ferrule-securing*,
(o) EN 13411-4 *Terminations for steel wire ropes – Safety – Part 4: Metal and resin socketing*,
(p) EN 13411-6 *Terminations for steel wire ropes – Safety – Part 6: Asymmetric wedge socket*,
(q) EN 13411-7 *Terminations for steel wire ropes – Safety – Part 7: Symmetric wedge socket*,
(r) EN 13557 *Cranes – Controls and control stations*,
(s) EN 13586 *Cranes – Access*,
(t) EN 13852-1 *Cranes – General-purpose offshore cranes*,
(u) EN 14502-1 *Cranes – Equipment for the lifting of persons – Part 1: Suspended baskets*,
(v) EN 14502-2 *Cranes – Equipment for the lifting of persons – Part 2: Elevating control stations*,
(w) EN 31010 *Risk management – Risk assessment techniques*.

1.9.6 International Standards:

(a) ISO Guide 73 *Risk management – Vocabulary*,
(b) ISO 281 *Rolling bearings – Dynamic load ratings and rating life*,
(c) ISO 898 *Mechanical properties of fasteners made of carbon steel and alloy steel*,
(d) ISO 15138 *Petroleum and natural gas industries – Offshore production installations – Heating, ventilation and air conditioning*,
(e) ISO 2232 *Round Drawn Wire for General Purpose Nonalloy Steel Wire Ropes – Specifications*,
(f) ISO 2408 *Steel wire ropes – Requirements*,
(g) ISO 2923 *Acoustics – Measurement of Noise on Board Vessels*,
(h) ISO 3108 *Steel wire ropes – Test method – Determination of measured breaking force*,
(i) ISO 3744 *Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane*,
(j) ISO 4309 *Cranes – Wire ropes – Care and maintenance, inspection and discard*,
(k) ISO 4413 *Hydraulic fluid power – General rules and safety requirements for systems and their components*,
(l) ISO 4414 *Pneumatic fluid power – General rules and safety requirements for systems and their components*,
(m) ISO 4871 *Acoustics – Declaration and verification of noise emission values of machinery and equipment*,
(n) ISO 5488 *Ships and marine technology – Accommodation ladders*,
(o) ISO 5817 *Welding – Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections*,
(p) ISO 6336 *Calculation of load capacity of spur and helical gears*,
(q) ISO 7010 *Graphical symbols – Safety colours and safety signs – Registered safety signs*,
(r) ISO 7061 *Ships and marine technology – Aluminium shore gangways for seagoing vessels*,
(s) ISO 7731 *Ergonomics – Danger signals for public and work areas – Auditory danger signals*,
(t) ISO 8566-1 *Cranes – Cabins and control stations – Part 1: General*,
(u) ISO 9001 *Quality management systems – Requirements*,
(v) ISO 9712 *Non-destructive testing – Qualification and certification of NDT personnel*,
(w) ISO 9927-1 *Cranes – Inspections – Part 1: General*,
(x) ISO 10474 *Steel and steel products – Inspection documents*,

(y) ISO 11201 *Acoustics – Noise emitted by machinery and equipment – Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections*,
(z) ISO 11688 *Acoustics – Recommended practice for the design of low-noise machinery and equipment*,
(aa) ISO 12100 *Safety of machinery – General principles for design – Risk assessment and risk reduction*,
(ab) ISO 12478-1 *Cranes – Maintenance manual – Part 1: General*,
(ac) ISO 12480-1 *Cranes – Safe use – Part 1: General*,
(ad) ISO 12482-1 *Cranes – Condition monitoring – Part 1: General*,
(ae) ISO 12944 *Paints and varnishes – Corrosion protection of steel structures by protective paint systems*,
(af) ISO 13702 *Petroleum and natural gas industries – Control and mitigation of fires and explosions on offshore production installations – Requirements and guidelines*,
(ag) ISO 13849 *Safety of machinery – Safety-related parts of the control systems*,
(ah) ISO 13850 *Safety of machinery – Emergency stop function – Principles for design*,
(ai) ISO 14120 *Safety of machinery – Guards – General requirements for the design and construction of fixed and movable guards*,
(aj) ISO 14122 *Safety of machinery – Permanent means of access to machinery*,
(ak) ISO 17894 *Ships and marine technology – Computer applications – General principles for the development and use of programmable electronic systems in marine applications*,
(al) ISO 19353 *Safety of machinery – Fire prevention and fire protection*,
(am) ISO 20332 *Cranes – Proof of competence of steel structures*,
(an) ISO 31000 *Risk management – Guidelines*,
(ao) IEC 60079 *Explosive atmospheres*,
(ap) IEC 60092-502 *Electrical installations in ships – Part 502: Tankers - Special features*,
(aq) IEC 60529 *Degrees of protection provided by enclosures (IP Code)*,
(ar) IEC 61000 *Electromagnetic compatibility (EMC)*,
(as) IEC 60204-32 *Safety of machinery – Electrical equipment of machines – Part 32: Requirements for hoisting machines*,
(at) IEC 60812 *Analysis techniques for system reliability – Procedure for failure mode and effects analysis (FMEA)*,
(au) IEC 61508 *Functional safety of electrical/ electronic/ programmable electronic safety-related systems*,
(av) IEC 61882 *Hazard and Operability Studies (HAZOP Studies) – Application Guide*,
(aw) IEC 61892-7 *Mobile and fixed offshore units – Electrical installations – Part 7: Hazardous areas*,
(ax) IEC 62443 *Security for industrial automation and control systems*,
(ay) IEC 62745 *Safety of machinery – Requirements for cableless control systems of machinery*,
(az) ISO 80079-36 *Explosive atmospheres – Part 36: Non-electrical equipment for explosive atmospheres – Basic method and requirements*,
(ba) ISO/IEC 27001 *Information technology – Security techniques – Information security management systems – Requirements*,
(bb) ISO/IEC 90003 *Software engineering – Guidelines for the application of ISO 9001:2008 to computer software*,
(bc) IMO MSC.1/Circ. 1331 *Guidelines for construction, installation, maintenance and inspection/survey of means of embarkation and disembarkation*,
(bd) IMO *Code on Alerts and Indicators, 2009*,
(be) IMO *International Code for the Application of Fire Test Procedures (2010 FTP Code)*,
(bf) IMO *Code for the Construction and Equipment of Mobile Offshore Drilling Units (2009 MODU Code)*,
(bg) IMO *International Convention for the Safety of Life at Sea (SOLAS), 1974*,
(bh) IMO SOLAS regulation II-1/3-9, *Means of embarkation on and disembarkation from ships*,
(bi) F.E.M. 1.001 *Rules for the design of hoisting appliances*,
(bj) EI *Model Code of Safe Practice Part 15: Area Classification for Installations Handling Flammable Fluids*,
(bk) ANSI/ISEA 121 *American National Standard for Dropped Object Prevention Solutions*,
(bl) API RP 505 *Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2*.

1.9.7 Recognised National or International Standards for the design of OPTS and/or their components may be accepted as equivalent to the requirements of this Code, provided LR is satisfied in each case that the standard adequately takes into account all necessary parameters (e.g. loads, environmental conditions, etc.) resulting from the intended mode of operation. The relevant

Standard is to be specified in the submission and agreement shall be requested (in accordance with *Ch 1, 1.9 Referenced Rules, Codes and Standards 1.9.1.(e)*) prior to the design process commencing.

1.10 Terms and definitions

1.10.1 **Active motion compensation** means the compensation of the motions of the mothership (and possibly also the target unit) to enable the safe transfer of personnel by means of a combination of a power source, a control system and a position/motion reference unit. *See Ch 1, 2.2 System types 2.2.1* for a detailed description.

1.10.2 **Base frame** is defined as the structure providing rigid support of the gangway and is usually located between the pedestal and/or the active motion compensation system and the gangway.

1.10.3 **Cargo basket or cargo trolley** is a mobile or fixed containment for goods, tools or similar items.

1.10.4 **Components** are all items which are essential for the operation of the system. Those components (structural, machinery, electrical/control) usually have well defined interfaces within the system boundaries of the OPTS (e.g. hydraulic cylinders, winches).

1.10.5 **Critical non-structural component** is a component of the OPTS where the failure of which may or will result in the loss of functionality or complete loss of the OPTS, e.g. control system, control panel.

1.10.6 **Critical structural component** is a structural member of the OPTS where the failure of which may or will result in the loss of the OPTS and/or one or more of its components in the main load-path and/or cause harm to any personnel, e.g. gangway chords and bracings, base frame, slewing ring, pedestal.

1.10.7 **Dead load** is the self-weight of any component of the OPTS which is not included in the Live Load.

1.10.8 **Design envelope** is the range of operational parameters, geometrical limitations, mothership motions, resulting loads, environmental conditions, etc. to which the OPTS is required to be designed.

1.10.9 **Effective gangway width** is the maximum span within which loads may be applied to the gangway flooring either by personnel or objects.

1.10.10 **Emergency situation** is defined as a hazardous situation needing to be urgently ended or averted which can arise during normal operation of the OPTS due to external influences, human interaction or as a consequence of a malfunction or failure of any part of the OPTS. The emergency situations need to be considered for exceptional design load cases.

1.10.11 **Essential feature**. A lifting appliance forms an essential feature if the purpose of the mothership is impaired if the lifting appliance is not functioning.

1.10.12 **Failure load** is the load when a structural member, component or other part of the OPTS has just reached its load bearing capacity and any further increase of the load will result in, e.g.:

(a) exceeding of yield strength; and/or
(b) exceeding of ultimate tensile strength; and/or
(c) exceeding of minimum breaking load; and/or
(d) immediate buckling; and/or
(e) mechanical components failing to fulfil their function.

1.10.13 **Free floating mode** is defined as the OPTS being in a state where the motions of the mothership and/or target unit are not actively compensated. Reference is made to *Ch 1, 1.10 Terms and definitions 1.10.1*.

1.10.14 **Flooring** is the supporting structure for persons using gangways, walkways, waiting areas, or similar structures and arrangements.

1.10.15 **Gangway** is the structure which is intended to support and guide the personnel on their way between the mothership supporting the OPTS and the target unit.

1.10.16 **Gangway tip** is the end of the gangway structure (including any telescopic part) which comes into contact with or is close to the target structure during personnel transfer.

1.10.17 **Guard** is a physical barrier to provide protection from machines and their components and parts which pose a potential hazard to personnel.

1.10.18 **Guard-rail** is a structure preventing persons falling from gangways, walkways, waiting areas and similar arrangements.

1.10.19 **Handrail** is a part of a guard-rail which persons hold onto while using gangways, walkways, waiting areas, and similar arrangements.

1.10.20 **Hazard** is a situation with the potential to cause harm to personnel, the OPTS, target unit/structure and supporting mothership in terms of its safety and integrity.

1.10.21 **Live load** is defined as the sum of the SWL_C (as defined in *Ch 1, 1.10 Terms and definitions 1.10.45*) and the static weight of any component of the appliance which is directly connected to, and undergoes the same motion as, the Safe Working Load during the lifting operation.

1.10.22 **Loose gear** is defined as hooks, hook blocks, shackles, blocks, swivels, chains, rings and similar items not permanently attached to the OPTS or items which can be removed and re-used elsewhere to serve a similar purpose under the same Safe Working Load or working load limit.

1.10.23 **LR Certificate** is defined as a certificate issued by LR based on the results of testing and inspection being satisfactorily carried out in accordance with the requirements of the *Rules for the Manufacture, Testing and Certification of Materials, July 2022*.

1.10.24 **Machinery components or systems** are defined as mechanical components which enable or aid the active or passive compensation function, or which otherwise assist in moving of structural components of the OPTS (e.g. winches, hydraulic cylinders, etc.).

1.10.25 **Main load-path** is, in general, defined as the route along the critical structural components of the OPTS, e.g. from the pedestal or foundation via an (optional) motion compensation system followed by the base structure, along the gangway and up to the gangway tip.

1.10.26 **Manufacturer's certificate validated by LR** is defined as a certificate issued by the manufacturer, validated by LR on the basis of inspection and testing carried out by the manufacturer and which is in accordance with the requirements of the *Rules for the Manufacture, Testing and Certification of Materials, July 2022*. In case of satisfactory validation, the certificate will include the following statement:

'We hereby certify that the material has been made by an approved process and satisfactorily tested in accordance with the Rules of Lloyd's Register.'

1.10.27 **Manufacturer's certificate** is defined as a certificate issued by the manufacturer based on the results of testing and inspection being satisfactorily carried out in accordance with the requirements of the *Rules for the Manufacture, Testing and Certification of Materials, July 2022*, or the applicable National or International Standard. The certificate is to be validated by the manufacturer's authorised representative, independent of the manufacturing department. The certificate will contain a declaration that the products are in compliance with the requirements of these Rules or the applicable National or International Standard. This certificate is equivalent to an inspection certificate EN 10204 *Metallic products – Types of inspection documents*, 3.1 (or ISO 10474 *Steel and steel products – Inspection documents*, 3.1) issued by the manufacturer of the materials.

1.10.28 **Mothership** is the vessel or (offshore) unit which carries the OPTS.

1.10.29 **Motion compensation** is the ability of the OPTS to fully or partly limit the translational and rotational motion effects of the moving mothership, i.e. dynamic: roll, pitch, yaw, heave, sway and surge, and static: heel and trim.

1.10.30 **Nominal gangway length** is the average of the maximum and minimum gangway length (e.g. considering telescopic extension).

1.10.31 **Off-board lift** is defined as a lifting operation which is not limited to the mothership usually taking place over the side of the mothership.

1.10.32 **Offshore crane** is defined as a crane used in an offshore environment which is handling cargo or personnel off-board the mothership usually by means of a boom or jib in combination with a winch and an associated reeving system.

1.10.33 **Offshore Personnel Transfer System (OPTS)** is defined as a system which is installed on-board the mothership with the purpose to provide safe transfer of personnel from the mothership to a fixed or floating target unit.

1.10.34 **On-board (internal) lift** is defined as a lifting operation which is limited to the mothership the appliance is installed on.

1.10.35 **Operator** is the person operating the OPTS with the responsibility for enabling the safe transfer of personnel between the mothership and the target unit via the target structure.

1.10.36 **Passive motion compensation** is defined as a system which requires no power source and no control system that enables motion compensation during the transfer of personnel. *See Ch 1, 2.2 System types 2.2.1* for a detailed description.

1.10.37 **Personnel** are the persons which are using the OPTS as a means to safely move/transfer between the mothership and the target unit.

1.10.38 **Personnel containment** is a structure enabling the support of persons in a limited and defined space by means of a basket or platform or similar structure.

1.10.39 **Platform** is defined as the means for providing support for personnel which are staying on such means for an extended period of time.

1.10.40 **Primary structural component** is a component which is not a critical structural component but is directly supporting personnel, e.g. walkways, flooring, handrails and their supports.

1.10.41 **Residual motion (including acceleration and inclination)** means any motion that remains uncompensated by the motion compensation system.

1.10.42 **Risk** is the likelihood that a specified undesired event will occur within a specified period of time, or under specified circumstances.

1.10.43 **Risk acceptance criteria** are the criteria to be applied to the results of the risk assessment, to demonstrate that the OPTS and supporting mothership are capable of providing an acceptable level of safety and integrity.

1.10.44 **Risk assessment** is the evaluation of the likelihood of specified undesired consequences to the safety and integrity of the OPTS and supporting mothership, together with the value judgements made concerning the significance of the results.

1.10.45 **Safe Working Load – Cargo (SWL_C)**. The general definition of the *SWL* is included in *Ch 1, 2.1 Safe Working Load (SWL) of a lifting appliance* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. Within the context of this Code, the SWL_C is related to cargo and is specifically defined as the weight of the cargo being handled by the OPTS crane functionality, usually employing falls and a winch.

1.10.46 **Safe Working Load – Cargo on Gangway (SWL_{CG})**. The general definition of the *SWL* is included in *Ch 1, 2.1 Safe Working Load (SWL) of a lifting appliance* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. Within the context of this Code, the SWL_{CG} is related to cargo and is specifically defined as the weight of the cargo being placed on the gangway (e.g. in a secured cargo basket at the gangway tip).

1.10.47 **Safe Working Load – Crane handling personnel (SWL_M)**. The general definition of the *SWL* is included in *Ch 1, 2.1 Safe Working Load (SWL) of a lifting appliance* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. Within the context of this Code, the SWL_M is related to handling of personnel (in a suspended basket) and is specifically defined as the weight of the personnel and equipment being handled by the OPTS crane functionality, usually employing falls and a winch.

1.10.48 **Safe Working Load – Personnel (SWL_P)**. The general definition of the *SWL* is included in *Ch 1, 2.1 Safe Working Load (SWL) of a lifting appliance* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. Within the context of this Code, the SWL_P is related to the transfer of personnel and is specifically defined as the weight of the personnel including light and portable equipment.

1.10.49 **Secondary structural component** is a component which is not a primary structural component, e.g. cable routings, etc.

1.10.50 **Significant wave height ($H_{1/3}$)** is defined as the average of the one third highest waves (measured from trough to crest) in a short-term wave measurement record.

1.10.51 **Supporting structure (pedestal or foundation)** is defined as the structure providing the base which is predominantly supporting the OPTS.

1.10.52 **Suspended basket** is a containment for personnel which is raised and lowered by means of falls and a winch.

1.10.53 **Target structure** is the structure to which the OPTS supported by the mothership will be aiming at, touching on or be connected to in order to enable personnel to move safely between the mothership and the target unit.

1.10.54 **Target unit** is the floating or fixed installation to which or from which personnel are being transferred by means of the OPTS installed on the mothership.

1.10.55 **Uniformly Distributed Load – Personnel (UDL_P)**. The uniformly distributed load, UDL_P, is related to the transfer of personnel and is specifically defined as the distributed load per area which comprises of the weight of the maximum possible number of personnel simultaneously and safely using the OPTS including applicable equipment.

1.10.56 **Walkway** is the means of providing support for personnel moving from one location to another on the OPTS.

1.11 Abbreviations

1.11.1 **ASD**

Allowable Stress Design

1.11.2 **CLAME**

Lloyd's Register's Code for Lifting Appliances in a Marine Environment

1.11.3 **COPTS**

Lloyd's Register's Code for Offshore Personnel Transfer Systems

1.11.4 **DP**

Dynamic Positioning

1.11.5 **EMC**

Electro Magnetic Compatibility

1.11.6 **EN**

European Norm (Standard)

1.11.7 **FAT**

Factory Acceptance Test

1.11.8 **FMEA**

Failure Mode and Effects Analysis

1.11.9 **FMECA**

Failure Mode, Effects and Criticality Analysis

1.11.10 **HAZID**

Hazard Identification

1.11.11 **HAZOP**

Hazard and Operability Study

1.11.12 **HPU**

Hydraulic Power Unit

1.11.13 **IACS**

International Association of Classification Societies

1.11.14 **ILO**

International Labour Organisation

1.11.15 **IMO**

International Maritime Organization

1.11.16 **ISO**

International Organisation for Standardisation

1.11.17 **ITP**

Inspection and Test Plan

1.11.18 **LRFD**

Load and Resistance Factor Design

1.11.19 **MCS**

Motion Compensation System

1.11.20 **MDT**

Minimum Design Temperature

1.11.21 **NDE**

Non-Destructive Examination

1.11.22 **NDT**

Non-Destructive Testing

1.11.23 **OPTS**

Offshore Personnel Transfer System

1.11.24 **PWHT**

Post Weld Heat Treatment

1.11.25 **QM**

Quality Management

1.11.26 **RBD**

Risk Based Design

1.11.27 **RMS**

Root Mean Square

1.11.28 **SAT**

Site Acceptance Text

1.11.29 **SF**

Safety factor

1.11.30 **SOLAS**

International Convention on the Safety of Life at Sea

1.11.31 **SWH**

Significant wave height

1.11.32 **SWL**

Safe Working Load

1.11.33 **UDL**

Uniformly Distributed Load

1.11.34 **WPS**

Welding Procedure Specification

1.11.35 **WPQ**

Welder Performance Qualification

1.12 Information to be submitted

1.12.1 The plans and information listed in this sub-Section are required to be submitted by the manufacturer (or designer) to LR enabling the classification or certification of an OPTS.

1.12.2 General arrangement plan of the OPTS, including details of the integration with and location (as applicable) on the mothership including all interfaces.

1.12.3 General arrangement plan showing details of escape and access routes and arrangements.

1.12.4 Detailed specification of the OPTS and design basis of the OPTS including:

(a) general system description;
(b) system type of the OPTS (*see Ch 1, 2.2 System types*);
(c) access type of the OPTS (*see Ch 1, 2.3 Access types*) including number of persons simultaneously allowed on the gangway;
(d) details of the operating cycle and modes (stowage, pre-service, in-service, post-service and stowage) and associated loads and location of personnel and Operator;
(e) description and/or illustration of flow of transferring personnel using the OPTS;
(f) Safe Working Loads or Uniformly Distributed Loads applicable to the OPTS (*see Ch 1, 3.3 Safe Working Load* and *Ch 1, 3.4 Uniformly Distributed Load*);

(g) configurations and geometrical limitations of the OPTS;
(h) maximum movements, angles, speeds and accelerations of the OPTS (and associated significant wave heights as applicable);
(i) details of the connection and disconnection system;
(j) station keeping performance (e.g. system capability plot) of the Dynamic Positioning (DP) System or other station keeping systems and arrangements (all as applicable);
(k) details of the stowage arrangement;
(l) operational profile, load spectra and design lifetime of the OPTS;
(m) access arrangements;
(n) details of any special operational (e.g. cargo trolley or basket) or non-operational (e.g. alternative stowage position) modes not listed in (d);
(o) detailed description of the motion compensation method, concept and system; and
(p) minimum and maximum design and operating temperatures.

1.12.5 Risk assessment and safety concept documentation (*see Ch 1, 10 Risk assessment*).

1.12.6 Instructions for use including, but not limited to:

(a) detailed description and conditions of normal operation personnel transfer and required condition of the OPTS to enable safe operation;
(b) detailed conditions and limitations of operation, use, access, environment (e.g. significant wave heights, wind, etc.), configuration, geometry, mothership characteristics, etc. and related safety measures;
(c) description and requirements for the state and design of the target structure;
(d) detailed installation procedure (including any tests, inspections, verifications, etc.) of the OPTS on-board;
(e) details of the Operators required:

- education and qualification
- training
- duties before, during and after operation;

(f) details of hazards to personnel within the operational area of the OPTS and on the OPTS;
(g) details of noise reduction measures;
(h) description and associated safety measures concerning limited or degraded operational modes;
(i) detailed description and conditions of pre- and post-operation measures (taking into service and taking out of service);
(j) maintenance requirements (including any testing requirements) in case no dedicated maintenance manual exists;
(k) communication requirements between:

- Operator and personnel to be transferred
- Operator and mothership
- Operator and target unit;

(l) safe access; and
(m) emergency, safety, evacuation and contingency procedures.

1.12.7 Maintenance manual and system addressing regular and irregular maintenance.

1.12.8 Emergency situations manual, if not part of the instructions for use, containing details of the handling of such situations, including:

(a) general emergency operational procedures and contingency plans;
(b) early warning escalation in order to enable safe completion or abortion of a transfer cycle (*see Ch 1, 9.4 Active systems (ST-A or ST-H) 9.4.7*);
(c) emergency stop;
(d) emergency disconnection;
(e) failure or damage of actuating system (e.g. hydraulic oil leakage, electrical cable damage);
(f) fire within the OPTS and its components and systems;
(g) Operator unable to continue his duties (e.g. passing out);
(h) mothership or target unit positioning system failure (e.g. DP failure);
(i) motion compensation system (or part of the system) degrading or degraded;

(j) overloading of the system (e.g. excessive number of personnel and/or equipment present on the gangway or in the personnel or cargo basket); and

(k) other emergency situations.

1.12.9 Calculations (or equivalent) clearly indicating the basis of design, operating criteria, dynamic loads, SWLs, UDLs, mothership accelerations and inclinations, wind loads, weights and centres of gravity of the OPTS parts, and relevant National or International Standards applied (*see Ch 1, 3 Loads and factors* and *Ch 1, 4 Load cases and load combinations*).

1.12.10 Scantlings, weld details, NDE and assembly plans of all critical and primary structural items comprising the OPTS, including the gangway/containment, base frame (supporting the gangway/containment), slewing ring, pedestals and stowage arrangements (all as applicable). Pedestals or foundation permanently attached to the mothership are a classification item where the mothership is classed with LR. Classification item, in this context, means that the pedestals or foundation are subjected to the classification procedures regardless of whether the OPTS is subject to certification or classification.

1.12.11 Specification of the materials applied in the main structural components including the pedestals/foundation.

1.12.12 Scantling plans and details of hydraulic cylinders. *See Ch 1, 3.6 Hydraulic cylinders* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

1.12.13 Details of sheaves, axles, pivot pins, wheels, slewing ring, slewing ring bolts, and other or similar items.

1.12.14 Details of blocks, chains, shackles, hooks and other loose gear items, indicating material, Safe Working Load (SWL), proof loads (PL) and the standard to which they have been manufactured.

1.12.15 The size, construction, finish and certified breaking loads of steel wire ropes and fibre ropes.

1.12.16 Information is to be provided on whether a particular component or structure is categorised as critical, primary or secondary structure (*see Ch 1, 1.10 Terms and definitions 1.10.40*, *Ch 1, 1.10 Terms and definitions 1.10.49* and *Ch 1, 1.10 Terms and definitions 1.10.39*).

1.12.17 Plans and calculations of machinery items, such as winch gearing, shafts, clutches, brakes, coupling bolts, welded drums, winch frame and similar items and their materials and stresses. In case the items are type approved by LR, the type approval certificates and supporting information are to be submitted for consideration in order to verify whether the actual OPTS design is compatible with the item and the related type approval.

1.12.18 Description of operation with explanatory diagrams of the motion compensation system including details of operating medium, i.e. pneumatic, hydraulic or electric schematics, including power packs and standby sources of power.

1.12.19 Inspection and Test Plan (ITP), including:

(a) inspection/survey plan;

(b) Factory Acceptance Test (FAT), including operational tests;

(c) pre-commissioning and commissioning procedures;

(d) on-board testing (or Site Acceptance Test (SAT)); and

(e) on-board overload and functional testing.

1.12.20 Plans of the circuit diagram of the electrical system, showing load currents and ratings of all electrical equipment, types and sizes of cables, rating type and make of all protecting devices.

1.12.21 Arrangement plan and circuit diagram of switchboard.

1.12.22 General arrangement of control stations (e.g. panels, consoles, cabins) and their locations and details of controls and displays.

1.12.23 Schematic diagrams of control circuits and panels, interlocks and alarm systems.

1.12.24 Details of the control, alarm and safety concept including:

(a) The overall system operational concept including a description of the intended operation of the control, alarm and safety systems. The description shall include a demonstration that the design provides an effective means of operation and control for all operating conditions.

(b) Details of alarms and warnings including intended Operator response and the message to be presented.

(c) Line diagrams of control circuits.

(d) Details of safety functions and devices (including securing and latching arrangements) and of any overrides, including consequences of use.

(e) List of monitored points.

(f) List of control points.
(g) Limit switches.
(h) Monitoring systems.
(i) Interface connections.
(j) Automatic safety systems and load limiting systems (if any) including certification details.
(k) Test schedules (for both works testing and trials) which should include methods of testing and test facilities provided.
(l) Where the design includes programmable electronic systems, the documentation listed in *Pt 6, Ch 1, 1.2 Documentation required for design review 1.2.6* of the *Rules and Regulations for the Classification of Ships, July 2022*.

See Ch 1, 3.7 Mechanical, electrical and control aspects of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

1.12.25 In addition, the following information is required for reference purposes: calculations of short-circuit currents and main bus-bars, sub-switchboard bus-bars and the secondary side of transformers.

1.12.26 The following information concerning the corrosion protection system shall be submitted, as a minimum:

(a) evidence that any primers used will have no deleterious effect on subsequent welding or on subsequent coatings;
(b) details of the painting specification with regard to:
    (i) the generic type of the coating and confirmation of its suitability for the intended environment;
    (ii) the methods to be used to prepare the surface before the coating is applied and the standard to be achieved. Reference should be made to established International or National Standards;
    (iii) the method of application of the coating; and
    (iv) the number of coats to be applied and the total dry film thickness;
(c) details of the areas to be coated;
(d) details of other means of corrosion protection (e.g. suitable material selection, galvanisation, cathodic protection), *see Ch 1, 12.6 Fabrication 12.6.10*; and
(e) Inspection and Testing Plan (ITP).

1.12.27 Information about the type of consideration and the possible review or appraisal status codes of the submitted documents are provided in *Table 1.1.2 Type of consideration and review/appraisal status*.

Table 1.1.2 Type of consideration and review/appraisal status

Document to be submitted	Reference	Type of consideration and possible review/appraisal status
Basic and general information		
General arrangement plans	*See Ch 1, 1.12 Information to be submitted 1.12.2* and *Ch 1, 1.12 Information to be submitted 1.12.3*	Noted
Specification and design basis of the OPTS	*See Ch 1, 1.12 Information to be submitted 1.12.4*	Noted
Risk assessment and safety concept	*See Ch 1, 1.12 Information to be submitted 1.12.5*	Noted
Instructions for use	*See Ch 1, 1.12 Information to be submitted 1.12.6*	Noted
Maintenance manual and system	*See Ch 1, 1.12 Information to be submitted 1.12.7*	Noted
Emergency situations manual	*See Ch 1, 1.12 Information to be submitted 1.12.8*	Noted
Calculations	*See Ch 1, 1.12 Information to be submitted 1.12.9*	Noted
Structural components related information		

Scantlings of all main structural items	*See Ch 1, 1.12 Information to be submitted 1.12.10*	Approved
Specification of the materials	*See Ch 1, 1.12 Information to be submitted 1.12.11*	Approved
Scantling plans and details of hydraulic cylinders	*See Ch 1, 1.12 Information to be submitted 1.12.12*	Approved
Sheaves, axles, pivot pins, wheels, slewing ring, slewing ring bolts, etc.	*See Ch 1, 1.12 Information to be submitted 1.12.13*	Approved
Items of loose gear	*See Ch 1, 1.12 Information to be submitted 1.12.14*	Approved
Steel wire ropes and fibre ropes	*See Ch 1, 1.12 Information to be submitted 1.12.15*	Approved
Indication of critical, primary or secondary structure	*See Ch 1, 1.12 Information to be submitted 1.12.16*	Approved
Machinery related information		
Machinery items	*See Ch 1, 1.12 Information to be submitted 1.12.17*	Approved
Description of operation	*See Ch 1, 1.12 Information to be submitted 1.12.18*	Noted
Survey related information		
Inspection and Test Plan (ITP)	*See Ch 1, 1.12 Information to be submitted 1.12.19*	Agreed (Notes 1 and 2)
Electrotechnical systems related information		
Plans of the circuit diagram of the electrical system (incl. switchboard)	*See Ch 1, 1.12 Information to be submitted 1.12.20* and *Ch 1, 1.12 Information to be submitted 1.12.21*	Approved
General arrangement of control stations	*See Ch 1, 1.12 Information to be submitted 1.12.22*	Noted
Schematic diagrams of control circuits and panels, interlocks and alarm systems	*See Ch 1, 1.12 Information to be submitted 1.12.23*	Approved
Control, alarm and safety concept	*See Ch 1, 1.12 Information to be submitted 1.12.24*	Approved
Calculations of short-circuit currents and main bus-bars, sub-switchboard bus-bars and the secondary side of transformers	*See Ch 1, 1.12 Information to be submitted 1.12.25*	Noted
Miscellaneous information		
Corrosion protection system	*See Ch 1, 1.12 Information to be submitted 1.12.26*	Agreed (Note 3)

Note 1: To be agreed between the designer/manufacturer and the attending LR Surveyor.

Note 2: The test procedure and test loads are to be submitted to the responsible LR plan appraisal office for approval.

Note 3: To be agreed between the designer/manufacturer and the LR Surveyor.

Section 2
Offshore Personnel Transfer System types

2.1 General

2.1.1 This Section briefly describes the main types of an OPTS which are currently in use in the industry. A systematic overview of an OPTS is shown in *Figure 1.2.1 Systematic overview of OPTS types and features*.

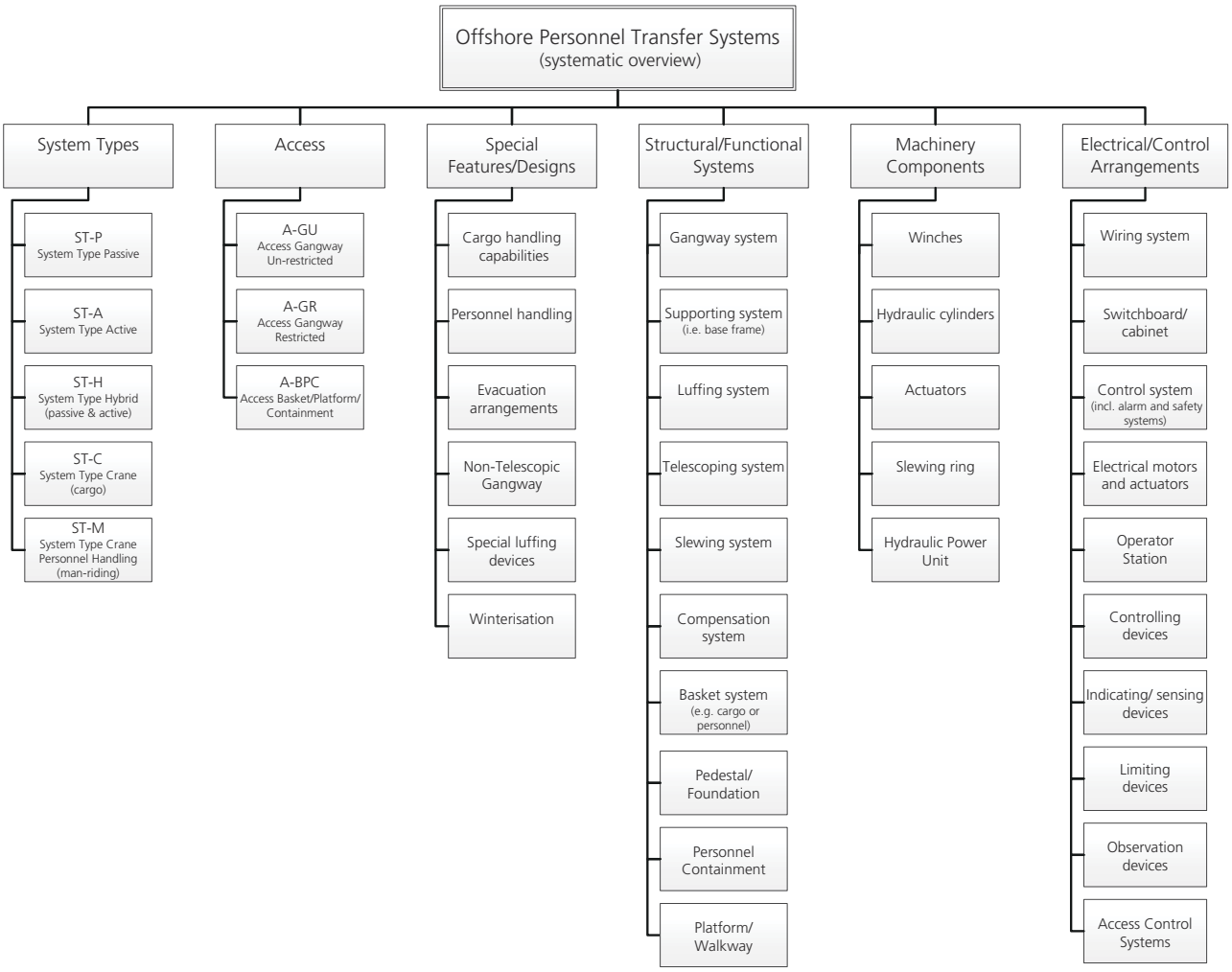

Figure 1.2.1 Systematic overview of OPTS types and features

2.2 System types

2.2.1 **ST-A** system types which provide a permanent active compensation may be described as systems where:

(a) the roll, pitch and yaw rotations and the surge, sway and heave motions are compensated by means of an active mechanical system enabling full compensation; or

(b) only certain degrees of freedom of movement are compensated, e.g. by compensation using telescoping, slewing and luffing motions only; and

(c) the connection time may be limited.

2.2.2 **ST-P** system types which provide a passive compensation may be described as systems where:

(a) the positioning of the gangway towards the landing area takes place by means of a manually operated but powered system;

(b) the gangway is finally landed on and safely connected to the target structure and the powered positioning system is deactivated, and all brakes are disconnected and/or valves are opened and the passive compensation of the gangway is realised; and

(c) the connection time may be unlimited.

2.2.3 **ST-H** system types are defined as hybrid systems in cases where a combination of passive (**ST-P**) and active (**ST-A**) systems is used and where:

(a) in the initial pre-operation phase the gangway is actively compensated until a connection to the target structure is established which allows safe transfer; and

(b) the system subsequently switches over to allow for passive compensation.

2.2.4 **ST-C** system types combine the personnel transfer capability (using the gangway as a conventional jib) with a dedicated cargo handling capability (e.g. using hoisting falls and a winch) and are also required to be designed as a conventional offshore crane complying with all relevant requirements.

2.2.5 **ST-A** and **ST-H** system types may combine personnel transfer capability with cargo transfer capability where the cargo is stored in dedicated cargo baskets at the tip of the gangway.

2.2.6 **ST-M** system types combine the personnel transfer capability (using the gangway as a conventional jib) with the personnel handling capability (using falls and a winch). In such cases the system is also required to be designed as an offshore crane with handling of personnel capability complying with all relevant requirements.

2.2.7 There may be combinations of the above defined systems types, e.g. **ST-HM** which defines a hybrid type system with crane cargo handling and personnel handling capability.

2.2.8 Systems other than those described in the above will be specially considered on the basis of this Code and the *Code for Lifting Appliances in a Marine Environment, July 2022* as applicable.

2.3 Access types

2.3.1 Three types of access systems are defined for the purposes of this Code:

(a) **A-GU**

OPTS which are designed to allow for unrestricted, unattended and/or uncontrolled access are abbreviated as A-GU. The system needs to be capable of being manually detached from the target structure and the OPTS and its gangway be brought to the stowage position.

(b) **A-GR**

OPTS where the access and the number of persons simultaneously allowed is restricted by defined means are abbreviated as A-GR. The system needs to be equipped with landing arrangements which can self-disconnect and the OPTS and its gangway be brought to the stowage position.

(c) **A-BPC**

OPTS which transfer personnel in a personnel containment (e.g. basket, platform, or other type of containment) designed for that purpose are abbreviated as A-PC. For a definition of personnel containment reference is made to *Ch 1, 1.10 Terms and definitions 1.10.38*.

2.3.2 Access types other than described in the above will be specially considered on the basis of this Code and the *Code for Lifting Appliances in a Marine Environment, July 2022* as applicable.

2.4 Connection types

2.4.1 For the connection between the gangway and the target unit the following connection types are defined:

(a) **Loose connection system**

The connection is made by means of pushing the gangway tip or the contact part of the personnel containment against the target structure with a defined pushing force compatible with the capacity of the target structure and the OPTS structure and gangway tip or personnel containment;

(b) **Fixed connection system**

The connection is made by a structural and/or mechanical arrangement ensuring permanent and safe connection between the target structure and the gangway tip or personnel containment.

2.5 Special features and designs

2.5.1 Apart from its main purpose to provide safe transfer of personnel, the OPTS may have additional functions or special design features, such as:

(a) Cargo handling capabilities either on the gangway, inside the personnel containment or by using the gangway or personnel containment supporting structure as a crane jib or similar designs.
(b) Personnel handling capabilities where the personnel are inside a suspended basket being hoisted and lowered by the OPTS using falls and a winch.
(c) Systems where non-telescoping gangways are used, e.g. personnel containment type systems or fixed gangway type systems.
(d) Systems where special luffing or heave compensation devices are employed, e.g. robotic structures supporting the personnel containment.
(e) Aiding, enabling or providing a secondary means of evacuation of the target unit to the mothership or vice versa.
(f) Operation of the system in arctic conditions (*see Ch 1, 8.27 Winterisation*).

2.5.2 The above and other features will be specially considered during the actual design appraisal of the individual project on the basis of this Code and the *Code for Lifting Appliances in a Marine Environment, July 2022* as applicable.

2.6 Structural and functional systems

2.6.1 The OPTS usually comprises the following components and systems:

(a) The gangway and related systems and structure which are necessary to enable safe passage and transfer of personnel from the mothership to the target unit and vice versa.
(b) The system and structure which is supporting the gangway or personnel containment structure which is defined as the base frame for the purposes of this Code.
(c) The system and structure which enable the luffing of the gangway structure or vertical movement of the personnel containment structure to enable compensation of mainly vertical mothership motions.
(d) The system and structure which provide the possibility of varying the length and reach of the gangway and using this for compensating for mainly horizontal mothership motions in the gangway direction.
(e) The system and structure which enable slewing of the gangway or personnel containment structure and system to compensate for horizontal motions in the transverse direction of the gangway/personnel containment structure.
(f) Any compensation system which is not realised by a combination of luffing, slewing and telescoping. It is possible that such a compensation system may still be combined with luffing and/or slewing and/or telescoping compensation systems.
(g) The walkways and waiting areas.
(h) The personnel containment system and structure for systems where no gangway is used to transfer personnel.

2.7 Machinery components

2.7.1 Machinery components of an OPTS may comprise (but are not limited to) the following items:

(a) winches;
(b) hydraulic cylinders;
(c) mechanical actuators;
(d) slewing rings; and
(e) hydraulic power units.

2.8 Electrotechnical systems and components

2.8.1 Electrotechnical systems and components of an OPTS may comprise (but are not limited to) the following items:

(a) electrical wiring system;
(b) electrical switchboard/cabinet including busbars;
(c) control system, including alarm and safety systems;
(d) electrical motors and actuators;
(e) Operator station and control panel;
(f) controlling devices;
(g) indicating/sensing devices;
(h) limiting devices;
(i) observation devices; and

(j) access control systems.

Section 3
Loads and factors

3.1 General

3.1.1 This Section describes and defines the loads considered necessary and relevant to be applied to an OPTS as a minimum.

3.1.2 Loads which are a result of the OPTS being used as a conventional offshore crane (e.g. ST-C with a SWL_{CG} and/or ST-M with a SWL_M) are to be taken from *Ch 4, 3 Offshore cranes* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. The requirements given in *Ch 4, 6 Handling of personnel* and *Ch 9, 4 Machinery engaged in handling of personnel* of the *Code for Lifting Appliances in a Marine Environment, July 2022* for an offshore crane engaged in the handling of personnel are also to be complied with.

3.1.3 Loads which are a result of any operation modes or designs of the individual OPTS which might not be detailed in this Section shall also be considered. Such additional loads are required to be agreed with LR prior to commencing of the project.

3.1.4 The typical loads and environmental parameters acting on an OPTS are shown in *Figure 1.3.1 Examples of principal loads acting on an OPTS*, which shows a typical ST-H OPTS.

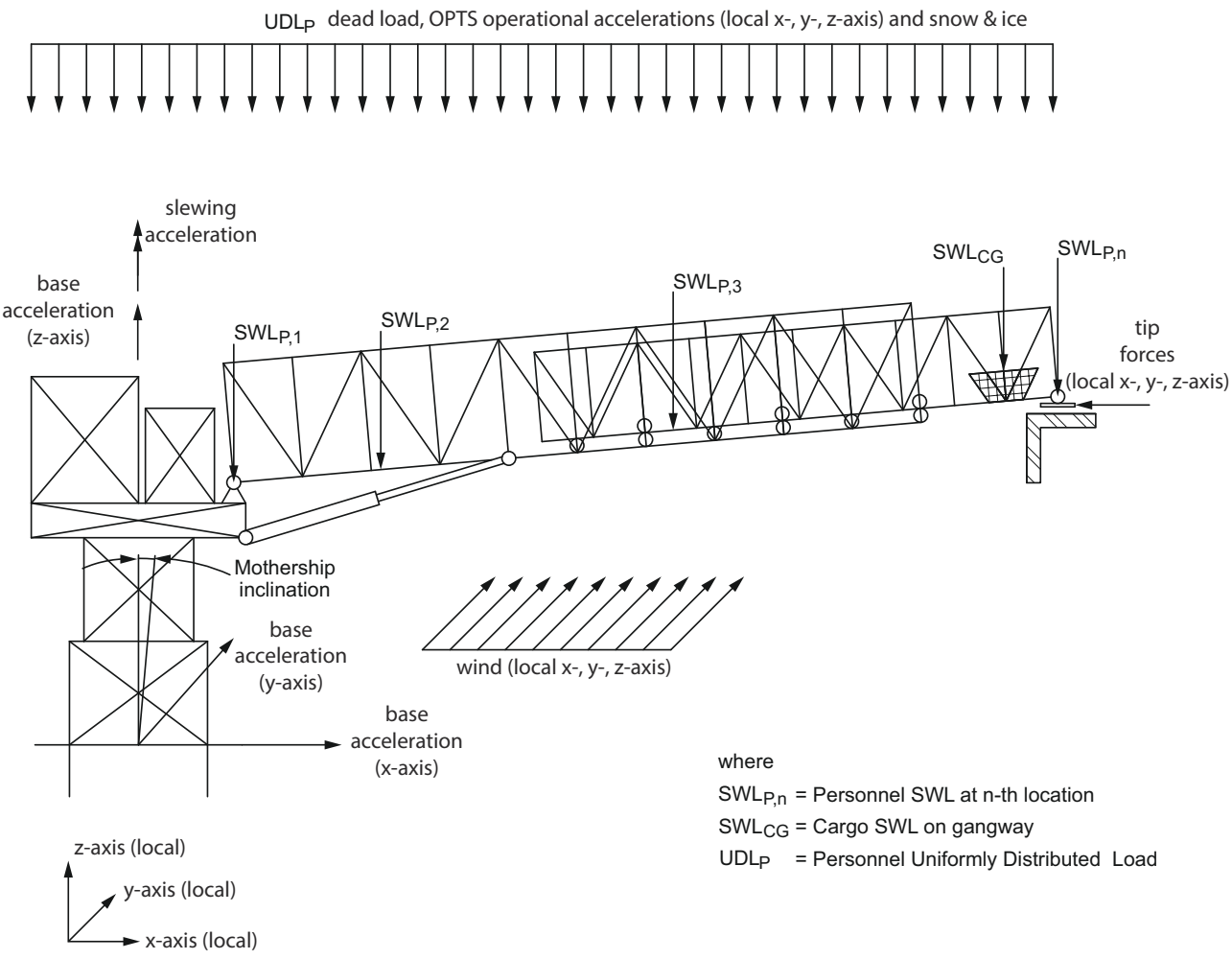

Figure 1.3.1 Examples of principal loads acting on an OPTS

3.1.5 The following in-service and out-of-service modes are to be considered for an OPTS, as a minimum:

(a) stowage (out-of-service);
(b) pre-operation phase (in-service);
(c) normal operation (in-service);
(d) post-operation phase (in-service);
(e) emergency and failure modes; and
(f) other modes depending on the special design of the OPTS, e.g. in-field transit.

The various modes are further described in the following paragraphs *Ch 1, 3.1 General 3.1.6* to *Ch 1, 3.1 General 3.1.11*.

3.1.6 During stowage the system is to be subjected to the following loads, as a minimum:

(a) dead loads;
(b) loads due to static and dynamic stowage specific mothership inclinations acting on the OPTS;
(c) inertia loads due to stowage specific mothership motions (i.e. vertical and horizontal accelerations) acting on the OPTS;
(d) stowage specific securing or restraining forces applied by means of system internal or external lashing devices;
(e) wind and other environmental effects (e.g. green sea); and
(f) snow and ice.

3.1.7 In the pre-operation phase the OPTS is usually released from its stowage arrangements. The following loads shall be considered in the pre-operation phase as a minimum:

(a) dead loads;
(b) personnel related SWL_P and/or UDL_P acting on structure, as applicable;
(c) cargo related SWL_{CG}, as applicable;
(d) loads due to static and dynamic mothership inclinations affecting the OPTS and its SWL_P and/or UDL_P acting on structure, as applicable;
(e) loads due to static and dynamic mothership inclinations affecting the SWL_{CG}, as applicable;
(f) wind forces and environmental effects (e.g. green sea);
(g) loads in operational phases where the motion compensation is inactive or non-existent:
    (i) Inertia loads due to mothership motions (e.g. vertical and horizontal accelerations) applied to the SWL_P, and/or UDL_P acting on structure, as applicable;
    (ii) Inertia loads due to mothership motions (e.g. vertical and horizontal accelerations) applied to the OPTS and acting on all components of the OPTS structure, as applicable; and
    (iii) Inertia loads due to mothership accelerations (vertical and horizontal) affecting the SWL_{CG};
(h) loads in operational phases where the motion compensation is active;
(i) Inertia forces due to accelerations caused by the compensation system (e.g. due to uncompensated motion or residual accelerations caused by not fully effective motion compensation) acting on all SWL, UDL and OPTS structure;
(j) forces due to OPTS movements, such as slewing, telescoping and luffing;
(k) snow and ice when considered relevant; and
(l) internal loads in the various components of the system, e.g. wire rope line pull for telescoping.

3.1.8 During normal offshore personnel transfer operations, the system shall be subjected to the following loads which are to be considered as a minimum:

(a) Dead loads;
(b) personnel SWL_P and/or UDL_P;
(c) cargo SWL_{CG} as applicable;
(d) loads due to static and dynamic mothership inclinations acting on the OPTS and its SWL_P, UDL_P and SWL_{CG};
(e) wind forces and environmental effects;
(f) inertia loads due to mothership accelerations (vertical and horizontal) acting on the **ST-P** system type OPTS and its SWL_P, UDL_P and SWL_{CG};
(g) inertia forces due to accelerations caused by the compensation system (e.g. due to residual accelerations caused by not fully effective motion compensation) for **ST-A** and **ST-H** system type OPTS;
(h) forces due to OPTS movements, such as slewing, telescoping and luffing;

(i) defined contact loads, e.g. from the gangway tip pushing with a defined pre-load against the target structure as specified by the designer/manufacturer;

(j) snow and ice when considered relevant; and

(k) internal loads in the various components of the system, e.g. wire rope line pull for telescoping.

3.1.9 Environmental conditions which result in green sea or any other wave loads hitting the gangway are not expected to occur during normal operation of the OPTS.

3.1.10 The post-operation phase is considered similar to the pre-operation phase in reverse order. In case the post-operation phase has special operational characteristics, any resulting loads which are not given in *Ch 1, 3.1 General 3.1.7* shall be taken into consideration. Personnel on the gangway or in the personnel containment are not expected during pre- or post-operation.

3.1.11 Other in-service or out-of-service modes may need to be considered depending on the individual design and/or environmental and/or local conditions of the OPTS.

3.1.12 The design analysis of the OPTS shall cover all geometric configurations and associated loading conditions.

3.1.13 All loads for the OPTS shall be associated with the mothership specific accelerations which are to be based on the location of the OPTS on the mothership and the significant wave heights. In case the mothership is not defined, a design envelope shall be defined which includes all loads which are relevant for the design of the OPTS. For each individual project it is to be ensured that this design envelope is not exceeded.

3.1.14 Where components (e.g. winches, hydraulic cylinders) are designed for a specific design envelope (i.e. minimum and maximum, as applicable, nominal static and dynamic interface loads), it is to be ensured that such design envelope loads are always equal or above the OPTS specific design interface loads.

3.1.15 The design life time for the OPTS shall be defined by the Owner/Operator but shall be taken as a minimum of 20 years. Appropriate fatigue calculations in accordance with a recognised National and International Standard shall be carried out for critical welds, parts and components in order to ensure that the desired life time will be reached. In special cases longer or shorter design life times may be agreed between the Owner/Operator, designer/manufacturer and LR.

3.1.16 Unless specified otherwise by the manufacturer, the design life of components which are subject to wear may be taken as 5 years and regular maintenance is to be ensured. The maintenance procedures need to ensure that components are replaced before a critical state is reached.

3.1.17 The co-ordinate system for the OPTS may be defined as follows:

(a) Origin: The origin may be taken at the location of the heel pin of the OPTS or a similar location depending on the individual design.

(b) X-axis: May be taken towards the longitudinal direction of the gangway or personnel containment where the positive direction is defined as ‘from gangway heel to gangway tip’.

(c) Y-axis: May be taken as the transverse direction of the gangway or personnel containment.

(d) Z-axis: May be taken as the vertical direction of the gangway or personnel containment where the positive direction is defined as ‘upwards’.

For an example of a co-ordinate system, *see Figure 1.3.1 Examples of principal loads acting on an OPTS*.

3.2 Dead load

3.2.1 The dead load of all structure, components, parts and arrangements is to be considered as its nominal weight. The nominal weight may be the conservatively calculated (i.e. use of negative plate thickness tolerances) or measured weight.

3.2.2 The dead load of travelling cargo trolleys is to be considered as part of the live load, i.e. SWL_{CG}.

3.2.3 The dead load of fixed cargo baskets is to be considered as part of the dead load.

3.2.4 The dead load is to be enhanced by the applicable risk coefficient as defined in *Ch 1, 3.8 Risk coefficient* in all load cases related to the lifting and transfer of persons.

3.3 Safe Working Load

3.3.1 For OPTS where the access is restricted (A-GR) the $SWL_{P,n}$ shall be applied. In case the OPTS is also used for cargo handling on the gangway the SWL_{CG} is to be considered in addition.

3.3.2 The Safe Working Load, $SWL_{P,n}$ is to be taken as:

$$SWL_{P,n} = mW_P$$

where

W_P = given weight per person of at least 120 kg which includes light equipment of up to 10 kg.

m = number of persons simultaneously using the OPTS under a controlled or restricted access regime.

n = n^{th} location of SWL_P on the gangway or in the personnel containment.

Note : The above definition of the *SWL* includes cases where *m* persons are moving along the gangway simultaneously at *n* locations.

If equipment heavier than 10 kg needs to be carried by the personnel, the value for W_P shall be adjusted to account for the higher weight. The limits according to labour law for persons carrying weight without supporting aids need to be complied with.

An emergency load of $SWL_{P.emergency}$ =360 kg shall be applied at the most unfavourable location on the gangway or personnel containment. This is considered to be equivalent to a minimum of two persons and a person on a stretcher. If the personnel containment is large enough to accommodate two persons and a person on a stretcher, this load shall be taken into account for a personnel containment type OPTS. Alternatively, the personnel containment specific emergency load $SWL_{P.emergency}$ shall be applied if this load is beyond 360 kg.

3.3.3 All SWL_P and SWL_{CG} loads shall be applied at unfavourable positions (e.g. causing maximum bending moments) and assuming unfavourable support conditions (e.g. cantilever position, supported at both ends, etc.) which may occur during in-service conditions.

3.3.4 If the OPTS is foreseen to be used in cases of emergency evacuation, the below defined UDL_P shall be applied as a design load and not the SWL_P.

3.3.5 Where the OPTS is also used as a conventional offshore crane with or without handling of personnel, the SWL_C and SWL_M are to be defined.

3.3.6 The above Safe Working Loads SWL_P, $SWL_{P.n}$, $SWL_{P.emergency}$ and SWL_M are to be enhanced by the applicable risk coefficient as defined in *Ch 1, 3.8 Risk coefficient*.

3.4 Uniformly Distributed Load

3.4.1 For OPTS where the access is unrestricted (A-GU) an UDL_P shall be applied.

3.4.2 The uniformly distributed load, UDL_P, is to be taken as:

UDL_P =360 kg/m^2

The above defined UDL_P shall also be applied to waiting zones before entering the actual gangway in case of A-GU type designs. Consideration may be given to technically justified proposals to apply lower UDL_P figures.

3.4.3 The UDL_P shall be partly applied to the gangway structure where this will lead to a higher utilisation of the OPTS assuming the most unfavourable support conditions (e.g. cantilever position, supported at both ends, etc.) possible.

3.4.4 The above uniformly distributed load, UDL_P, is to be enhanced by the applicable risk coefficient as defined in *Ch 1, 3.8 Risk coefficient*

3.4.5 This above defined Uniformly Distributed Load, UDL_P shall be further increased by the mothership accelerations and loads from any compensated or uncompensated (residual) motions of the OPTS. The inclinations of the mothership shall also be taken into consideration.

3.5 Loads on floorings

3.5.1 Floorings are to be designed for the following loads and do not need to be applied simultaneously:

(a) Case A: Distributed load of 360 kg/m^2; and

(b) Case B: Local load of 310 kg on any individual member.

3.5.2 For both cases, the mothership accelerations and loads from any compensated or uncompensated (residual) motions of the OPTS shall be applied. These loads are to be further enhanced by the applicable risk coefficient as defined in *Ch 1, 3.8 Risk coefficient*. The allowable stresses shall be calculated as per *Ch 1, 5 Allowable stresses and safety factors* using the stress factor as defined in *Table 1.4.2 Stress factors for the defined load cases* for Case 1.

3.6 Loads on platforms and walkways

3.6.1 The distributed load on platforms and walkways shall be a minimum of 360 kg/m^2 and a concentrated load of 310 kg at the most unfavourable location on the platform or walkway. These loads do not need to be applied simultaneously. These loads shall be increased by the mothership accelerations and loads from any compensated or uncompensated (residual) motions of the OPTS. The inclinations of the mothership shall also be taken into consideration. These loads are to be further enhanced by the applicable risk coefficient as defined in *Ch 1, 3.8 Risk coefficient*.

3.6.2 The distributed load shall be applied to the platform or walkway structure in such a way that leads to the highest utilisation of the OPTS or platform or walkway structure. This could mean that the distributed load may only be partly applied to the OPTS or walkway or platform area.

3.7 Loads on handrails

3.7.1 Handrails and their supporting structure (e.g. guard rails and stanchions) shall be designed to a minimum distributed load of 51 kg/m without permanent deformation. This distributed load may be increased by the mothership accelerations and loads from motions of the OPTS. The inclinations of the mothership shall also be taken into consideration. This load is further to be enhanced by the applicable risk coefficient as defined in *Ch 1, 3.8 Risk coefficient*

3.8 Risk coefficient

3.8.1 To account for the increased risk associated with personnel handling the following risk coefficients shall be applied for the design of the OPTS:

(a) for SWL_P: $\gamma_{n.SWL}$ = 1,30;

(b) for UDL_P: $\gamma_{n.UDL}$ = 1,60; and

(c) for dead loads: $\gamma_{n.DL}$ = 1,10.

3.8.2 The above defined risk coefficients shall be used to enhance the values of the *SWL*, *UDL* and dead load and are to be applied for allowable stress design (ASD) and load and resistance factor design (LRFD).

3.8.3 The risk coefficients shall be applied to all operational and non-operational loads, including emergency loading conditions, where lifting, supporting and transfer of personnel is carried out.

3.8.4 Proposals for the application of alternative risk factors will be specially considered if supported by an acceptable technical justification.

3.9 Hoisting factor

3.9.1 The application of a hoisting factor for the personnel transfer function of the OPTS is not required. If the OPTS is also designed to be used as a conventional offshore crane, a hoisting factor is required to be applied (*see Ch 4, 3.3 Dynamic forces* of the *Code for Lifting Appliances in a Marine Environment, July 2022*). This is also to be applied for systems where the crane part of the system is engaged in the handling of personnel (i.e. lifting of personnel in a suspended basket). Reference is made to *Ch 1, 3.1 General 3.1.2*.

3.10 Duty factor

3.10.1 The application of a duty factor for the personnel transfer function of the OPTS is not required. If the OPTS is also designed to be used as a conventional offshore crane, a duty factor is required to be applied (*see Ch 4, 3.2 Service category and duty factor* of the *Code for Lifting Appliances in a Marine Environment, July 2022*) to the purpose of serving as an offshore crane. This is also to be applied for systems where the crane part of the system is engaged in the handling of personnel (i.e. handling of personnel in a suspended basket). Reference is made to *Ch 1, 3.1 General 3.1.2*.

3.11 Mothership motions and accelerations

3.11.1 Inertia forces acting on the OPTS due to mothership motions shall be specified by the Owner/Operator for all in-service and out-of-service (e.g. stowed for voyage or in-field transit) situations. The translational and angular accelerations resulting from the mothership motions shall be defined for each of the given in-service or out-of-service significant wave heights and shall also be associated with the location on the mothership.

3.11.2 If the actual mothership is unknown, and consequently actual accelerations are not available, the OPTS shall be designed for a given set of maximum accelerations which shall contribute to the design load envelope.

3.11.3 The residual accelerations as a result of uncompensated mothership motions are to be considered. The residual component accelerations shall be taken as at least 15 per cent of the maximum uncompensated component accelerations for the applicable operational load case and associated significant wave height. If the motion compensation system cannot achieve less

than 15 per cent of the maximum uncompensated component accelerations the actual residual accelerations are to be applied in the design calculations. Lower residual accelerations than the minimum of 15 per cent may be applied if it can be demonstrated that those can be reliably achieved by the system.

3.11.4 Where sinusoidal motions are used to establish design accelerations, the maximum and residual acceleration calculations should be made for a range of likely motion periods. Where random motions are used to establish design accelerations, the maximum acceleration a_{max} shall be taken as 3,72 times the RMS acceleration, i.e.:

$$\left(a_{\max} = \max \begin{Bmatrix} \left| a_{\text{mean}} + 3{,}72\, a_{\text{RMS}} \right| \\ \left| a_{\text{mean}} - 3{,}72\, a_{\text{RMS}} \right| \end{Bmatrix} \right)$$

If time domain simulation is used, the RMS accelerations shall be established over at least 10 minutes full scale simulation time.

3.11.5 In the absence of specific information, and for guidance purposes, the vessel accelerations may be calculated as outlined in *Pt 3, Ch 9 Special Features* of the *Rules and Regulations for the Classification of Ships, July 2022*, where the wave height factor shall be taken as:

$$f_{\text{Hs}} = f_{\text{H 1/3}} = \frac{H^{1/3}}{5{,}5}$$

where

$H_{1/3}$ = significant wave height, in m

Note For purposes of the calculation of vessel accelerations according to the above defined methodology, design significant wave heights $H_{1/3}$ greater than 4,5 m will be specially considered.

3.11.6 The vertical and horizontal location of the OPTS and its components shall be taken into consideration for the application of accelerations, e.g. an OPTS installed at the stern or bow of the mothership usually results in higher accelerations than an OPTS installed at midships of the mothership. An OPTS located close to the port side or starboard side of the mothership will also experience higher accelerations than an OPTS installed close to the centreline of the mothership.

3.11.7 Any movement of the target unit shall also be taken into consideration where the gangway or personnel containment may come in contact with the target structure. Combined accelerations of the mothership and the target unit need to be considered as applicable (e.g. when the gangway is resting on the target structure in passive mode). Representative values for the target unit accelerations shall be agreed with LR.

3.11.8 The performance of mothership stabilisation systems such as anti-roll tanks or Dynamic Positioning may be included when defining the mothership motions and accelerations.

3.12 Static inclinations

3.12.1 The static inclinations of the mothership shall be considered for the OPTS.

3.12.2 Static inclinations shall be provided by the Owner/Operator of the mothership. In the absence of such information the values in *Table 1.3.1 Static inclination angles for different unit types* may be applied.

Table 1.3.1 Static inclination angles for different unit types

OPTS installed on	Heel / Trim
Mono-hull mothership	5,0° / 2,0°
Semi-submersible mothership	3,0° / 3,0°
Fixed unit	1,0° / 1,0°

3.12.3 As an OPTS is usually capable of slewing around its centreline at the base structure, load cases shall be considered where the heel and trim angles of the mothership are combined in a resulting angle δ as per the following equation:

$$\delta = \arctan\left(\sqrt{(\tan(\text{heel}))^2 + (\tan(\text{trim}))^2}\right)$$

3.12.4 The minimum possible combinations are given in *Table 1.3.2 Minimum possible combinations of load angles*. In this table pairs of load angles are provided which can be used for the analysis of the OPTS.

Table 1.3.2 Minimum possible combinations of load angles

Combination No.	Load angles	
	α	β
1	+δ	0
2	+heel	+trim
3	+trim	+heel
4	0	+δ
5	-trim	+heel
6	-heel	+trim
7	-δ	0
8	-heel	-trim
9	-trim	-heel
10	0	-δ
11	+trim	-heel
12	+heel	-trim

3.12.5 The rolling and pitching motions alternate around static heel and trim angles. The effects of the final maximum static angles of roll and pitch, which include static heel and trim angles, shall also be taken into consideration.

3.12.6 The load reducing effects of an installed motion compensation system may be considered. Components of the OPTS which are affected by the load reduction shall be subjected to a minimum of 15 per cent of the static inclination angles due to residual inclinations which may not be compensated by the system at all times. Lower inclinations than the minimum of 15 per cent may be applied if it can be demonstrated that those can be reliably achieved by the system.

3.13 Dynamic forces due to travelling, slewing, telescoping and luffing

3.13.1 Dynamic forces due to travelling, slewing, telescoping and luffing motions are to be taken into consideration as applicable to the individual design. Centrifugal forces due to slewing are also required to be taken into consideration as they may be significant in active motion compensated systems. Any proposal to omit centrifugal forces will be specially considered.

3.13.2 The actual speed and acceleration and deceleration times shall be used to determine the inertia forces.

3.14 Wind

3.14.1 The forces due to wind shall be applied to the system and components directly exposed to wind action. Wind action on shielded surfaces shall also be appropriately considered. *See Ch 4, 2.12 Wind loading* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

3.14.2 The following design wind speeds shall be applied, as a minimum:

(a) In-service operation: $v_{\text{In-service}}$ = 20 m/s

(b) Out-of-service: $v_{\text{Out-of-service}}$ = 63 m/s

3.14.3 The design wind speeds as defined in *Ch 1, 3.14 Wind 3.14.2* are related to a gust wind velocity averaged over a period of 3 seconds.

3.14.4 The application of higher in-service design wind speeds needs to be considered to match the design environmental conditions (e.g. significant wave height). *See Ch 1, 2.3 Service category 2.3.2* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

3.14.5 The actual operational wind speeds for personnel transfer operations shall be less than the above design wind speeds (*see Ch 2, 3.5 Environmental aspects 3.5.1*).

3.14.6 Methods to evaluate loads due to wind action are given in *Ch 4, 2.12 Wind loading* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. Alternative proposals to determine loads due to wind in compliance with recognised National or International Standards will be specially considered.

3.15 Stowage

3.15.1 The loads due to stowage acting on the OPTS and its components are in general to be taken into account as per the requirements as stated in *Ch 4, 2.11 Forces due to ship motion* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

3.15.2 The stowage loads may be calculated based on the design conditions as given in *Ch 4, 2.11 Forces due to ship motion 2.11.3* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

3.15.3 Where the mothership characteristics are known, the method given in *Ch 4, 2.11 Forces due to ship motion 2.11.4*, *Ch 4, 2.11 Forces due to ship motion 2.11.5* and *Ch 4, 2.11 Forces due to ship motion 2.11.6* of the *Code for Lifting Appliances in a Marine Environment, July 2022* shall be applied.

3.15.4 Stowage loads based on model tests or hydrodynamic calculations of the mothership may also be applied instead of *Ch 1, 3.15 Stowage 3.15.2*.

3.15.5 Snow and ice loads are to be considered as defined in *Ch 1, 3.17 Snow and ice*.

3.15.6 The effects of green sea need to be taken into consideration in cases where the stowage arrangements and location on the mothership may result in significant green sea loads.

3.15.7 Actual stowage load data as per *Ch 1, 3.15 Stowage 3.15.3* or *Ch 1, 3.15 Stowage 3.15.4* is to be preferred over the general method as given in *Ch 1, 3.15 Stowage 3.15.2*. Due care is to be taken in cases where the OPTS is not permanently installed on a dedicated mothership. In such cases, it is to be ensured that the design stowage loads are always greater than the stowage loads of the actual mothership on which the movable OPTS is installed.

3.15.8 Alternative proposals to calculate the stowage loads for the OPTS will be specially considered.

3.15.9 In case in-field transit is considered in the OPTS concept, lower loads corresponding to the in-field-transit mode may be accepted.

3.15.10 For a definition of the different stowage cases, general transit/voyage (stowage/survival) and in-field transit, *see Ch 1, 4.3 General transit/voyage (stowage/survival) and in-field transit load combinations*.

3.16 Emergency scenarios and loads

3.16.1 The risk assessment shall identify and define possible emergency scenarios and hazards.

3.16.2 Based on the results of the risk assessment (*see Ch 1, 10 Risk assessment*) possible emergency loads are to be developed and defined. Any relevant loading scenarios as a result of the risk assessment shall be included in the design load cases for the OPTS.

3.16.3 Examples for such scenarios are given, but shall not be limited to the following:

(a) Single point failure of any single component resulting in emergency loads beyond those of normal operation or stowage.
(b) Partial failure of the motion compensation system (e.g. resulting in increased mothership accelerations).
(c) Complete failure of the motion compensation system (e.g. resulting in uncompensated mothership accelerations).
(d) Control system failure causing the failure of any type of motion compensation system or other parts of the OPTS.
(e) Failure of certain system components (e.g. resulting in increased or uncompensated mothership accelerations).
(f) Burst of a hydraulic hose causing the pilot operated non-return valve of the hydraulic cylinder to lock the cylinder rod.
(g) Exceeding of geometrical design limits, e.g. steel to steel contact of hydraulic cylinder parts.
(h) Falling below the minimum specified ambient operating temperature, combined with the occurrence of impact forces.
(i) Impact loads at the gangway tip or the personnel containment due to inaccurate or inadequate operation or failure of components or systems. The applied impact load shall be at least 25 per cent above the set level of any load limit sensors, e.g. contact pre-load of the telescopic gangway system, slewing motor load limit setting, etc.
(j) Emergency disconnection (lift-off), e.g. due to exceeding of design envelope (e.g. exceeding of design loads or geometrical design limits, etc.).
(k) Emergency stop.
(l) Accidental wave loads or green seas acting on the gangway and/or OPTS structure during stowage and normal operation.

(m) Consideration of the 'double angle effect', where the OPTS motion compensation system might have stopped operating due to a failure or due to an emergency stop activation in an unfavourable moment resulting in potentially twice the design mothership inclination the OPTS has been designed for.

(n) Exceeding of geometrical limitations of the OPTS.

(o) Rescue of a person on a stretcher.

(p) Other aspects depending on the design of the OPTS and the risk assessment may need to be considered.

3.16.4 The above described emergency scenarios and other similar events are to be categorised as load case 4 events as defined in *Ch 4, 2.15 Load combinations* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

3.16.5 For **ST-A** and **ST-H** system types OPTS, the design analysis in an emergency case of compensation system failure shall cover all the loads specified in *Ch 1, 3.1 General 3.1.8*, however, the inertia loads due to the mothership accelerations acting on the OPTS dead load and its SWL_P, UDL_P and SWL_{CG} shall be taken as full accelerations without compensation.

3.16.6 If the OPTS has experienced any of the above emergency scenarios and/or loads, the OPTS is to be taken out of service and shall be thoroughly examined before being put back into use.

3.17 Snow and ice

3.17.1 In general, the effects of snow and ice loads acting on the OPTS structure do not need to be considered, except where a particular design or application indicates that these loads are significant.

3.17.2 If the risk assessment results in the conclusion that in certain areas of the system the presence of ice will not cause any hazards for personnel (e.g. due to dropped objects) and equipment, ice may be allowed in such areas. In such cases the load increasing effects of ice need to be considered.

3.17.3 The effects of snow and ice shall be considered for the calculation of the area exposed to wind in the stowage load case.

3.17.4 For the stowage load case the loads from snow and ice shall be taken as 400 kg/m^3 for snow and as 900 kg/m^3 for ice. The minimum thickness to be considered shall be 100 mm. Alternative proposals for consideration of snow and ice loads will be specially considered.

3.17.5 The risk (and its mitigation) of ice dropping from the system and its components with the potential to result in injured personnel needs to be considered in the risk assessment.

3.18 Temperature effects

3.18.1 The effects of temperature shall be considered predominantly with respect to the selection of steel. Reference is made to *Ch 4, 2.14 Temperature effects 2.14.1* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

3.18.2 Loads resulting from the effects of restraint due to thermal expansion/contraction shall be considered as applicable.

3.18.3 Hazards originating from temperature effects shall be taken into consideration. Reference is made to *Ch 1, 10 Risk assessment*.

3.19 Design loads for components

3.19.1 Components may be designed for their own independent design loads in order to enable independent certification of such components. It must be ensured that the chosen design loads are in all cases compatible with the dynamic loads originating from the actual OPTS design load at the interface with the component. Any dynamic effects (such as mothership accelerations), risk coefficients and other design factors and loads are to be taken into account when comparing OPTS design interface load with the component design load.

3.19.2 The following components have the potential to be considered for their own design loads, e.g.:

(a) winches;

(b) hydraulic cylinders;

(c) electro-mechanical actuators;

(d) items of loose gear;

(e) slewing rings; and

(f) wire rope sheaves.

Other components will be specially considered.

3.20 System internal forces

3.20.1 System internal forces, such as resistance forces due to friction of sliding and guiding surfaces between the telescoping and non-telescopic parts of the gangway shall be taken into consideration. The friction coefficients are usually subjected to variation, e.g. depending on condition of the lubrication system, etc. Therefore, the minimum and maximum values of the friction coefficients shall be considered.

3.20.2 Forces due to inertia, such as acceleration and deceleration forces of the telescopic part of the gangway in the longitudinal direction of the gangway shall also be taken into consideration.

3.20.3 In order to ensure safe operation, it is usually required that direct contact between the gangway tip (or the personnel containment structure) and the target structure is established. The forces due to that direct contact need to be considered in the system design. The longitudinal contact load shall be based on the residual inaccuracy of the motion compensation system and the maximum pushing force the system can apply (e.g. due to telescoping action). The transverse contact force shall be based on the residual inaccuracy of the motion compensation system and the maximum slewing moment the system can apply. Alternative proposals for the application of such contact forces will be considered.

3.21 Contact loads

3.21.1 Contact loads are defined as loads which occur due to the gangway tip or personnel containment coming into contact with the target unit via the target structure.

3.21.2 Loads due to set pre-loads (e.g. due to predefined contact load from the telescopic system of the gangway) are to be taken into consideration as operational loads.

3.21.3 Loads due to uncompensated (residual) motion are to be taken into account.

3.21.4 The whole OPTS structure, and particularly the structure at the gangway tip or personnel containment, is to be designed to resist such contact forces combined with all other normal operation loads or emergency loads respectively.

3.22 Special loads

3.22.1 Where the OPTS is intended to be used and is designed for special operational or environmental scenarios which will result in loads in excess of or in addition to those given in this Section, these loads are required to be taken into consideration. An example of such a scenario is the use of the OPTS gangway as a support for items other than personnel or cargo, e.g. fire hoses.

3.22.2 Loads due to wind induced vibrations (commonly known as vortex shedding) may need to be taken into consideration. The effects of vortex shedding, in particular, where the exciting frequency is near or matching the eigenfrequency is further to be taken into consideration. Any effects of possible fatigue damage may need to be assessed.

3.22.3 Other special loads may need to be considered and may be the result of the risk assessment.

3.22.4 All scenarios resulting in special loads are required to be described in detail and shall be agreed with LR.

■ *Section 4*
Load cases and load combinations

4.1 General

4.1.1 For the structural design of the OPTS the following four cases are required to be considered:

(a) Case 1: In-service - OPTS engaged in personnel or cargo transfer operations (without wind).
(b) Case 2: In-service - OPTS engaged in personnel or cargo transfer operations (with wind).
(c) Case 3: Out-of-service - OPTS engaged in in-field transit or general transit/voyage (stowage/survival) conditions (with wind).
(d) Case 4: In-service or out-of-service or load testing - OPTS subjected to emergency or exceptional conditions (with wind).

4.2 Operational load combinations

4.2.1 Typical in-service load combinations are defined as follows and are associated with load combination Cases 1 and 2:

(a) normal personnel transfer operations;
(b) normal cargo operations for OPTS with cargo handling facilities; and
(c) combinations of load combinations (a) and (b) will be specially considered.

4.2.2 Load combination cases.

- **Case 1a and Case 1b**

  Load combination Case 1a is defined as being the personnel transfer in-service design case while load combination Case 1b is defined as being the cargo operational mode both without the effects of wind. The conditions, configurations, effects and loads to be considered as a minimum are given in *Table 1.4.1 Conditions, configurations, effects and load types*.

- **Case 2a and Case 2b**

  Load combination Case 2a is defined as being the personnel transfer in-service design case while load combination Case 2b is defined as being the cargo operational mode both including the effects of wind. The conditions, configurations, effects and loads to be considered as a minimum are given in *Table 1.4.1 Conditions, configurations, effects and load types*.

4.3 General transit/voyage (stowage/survival) and in-field transit load combinations

4.3.1 In-field transit and general transit/voyage (stowage/survival) out-of-service load combinations are defined as follows and are associated with load combination Case 3:

(a) **General transit (stowage/survival)**

General transit is usually defined as the voyage from one field of operation to another where extreme (survival) environmental conditions may occur and the OPTS needs to be subjected to maximum stowage arrangement.

(b) **In-field transit**

In-field transit is usually defined as the voyage within a defined field of operation where the mothership is moving within the field from one operational location to another.

4.3.2 Load combination case.

- **Case 3**

  The effects and loads to be considered as a minimum are given in *Table 1.4.1 Conditions, configurations, effects and load types*.

4.4 In-service and out-of-service emergency/exceptional load combinations

4.4.1 The following in-service and out-of-service emergency and exceptional scenarios, loads and load combinations shall be taken into consideration as a minimum and are associated with load combination Case 4, such as:

(a) system fault scenarios (e.g. software failure modes in case those have the potential to lead to exceptional loads);
(b) proof load testing;
(c) failure of the power supply;
(d) failure of control system;
(e) failure of components;
(f) emergency disconnection (lift-off);
(g) injured person to be rescued (e.g. two persons plus one person on a stretcher);
(h) failure of mechanical components; and
(i) 'redundancy situations' (e.g. failure of one hydraulic cylinder in a two hydraulic cylinder design).

4.4.2 Load combination cases.

- **Case 4a, Case 4b and Case 4c**

  Load combination Case 4a is defined as being the personnel transfer emergency design case, load combination Case 4b is defined as being the cargo emergency design case and load combination Case 4c is defined as being the proof load testing design case. The effects and loads to be considered as a minimum for exceptional and emergency cases are given in *Table 1.4.1 Conditions, configurations, effects and load types*.

4.5 Load combination overview

4.5.1 *Table 1.4.1 Conditions, configurations, effects and load types* provides an overview of what conditions/configurations, effects and loads are to be considered in which load combination case. Further details can be found in *Ch 1, 4.2 Operational load combinations*, *Ch 1, 4.3 General transit/voyage (stowage/survival) and in-field transit load combinations* and *Ch 1, 4.4 In-service and out-of-service emergency/exceptional load combinations*.

Table 1.4.1 Conditions, configurations, effects and load types

Condition/ configuration, effect or load type	**Reference**	**In-Service (operation)** Note 1				**Out-of-Service (stowage/ survival)** Note 1	**In-Service or Out-of-Service (emergency/ exceptional)** Note 1		
		Case 1a	**Case 1b**	**Case 2a**	**Case 2b**	**Case 3**	**Case 4a**	**Case 4b**	**Case 4c**
Dead load	Note 3	X	X	X	X	X	X	X	X
Loads due to personnel transfer operations	Note 4	X	(X) Note 2	X	(X) Note 2	—	X	(X) Note 2	—
Loads due to cargo handling operations	Note 5	(X) Note 2	X	(X) Note 2	X	—	(X) Note 2	X	—
Proof load test loads	Note 6	—	—	—	—	—	—	—	X
Mothership accelerations (e.g. related to the specified values of $H_{1/3}$ for in-service, out-of-service and exceptional conditions, as applicable)	Note 7	X	X	X	X	X	X	X	—
Mothership static inclinations	Note 8	X	X	X	X	X	X	X	—
Equipment modes (condition, configurations, motions, accelerations, etc.) and resulting loads	Note 9	X	X	X	X	X	X	X	X
Loads required as a result of the risk assessment	Note 10	X	X	X	X	X	X	X	X

Other loads, not listed in the above, demanded by the actual design of the OPTS and/or by environmental conditions and/or by the specific mothership design	Note 11	X	X	X	X	X	X	X	X
Effects of wind	Note 12	—	—	X	X	X	X	X	—
Exceptional and emergency scenarios and loads	Note 13	—	—	—	—	—	X	X	—
Loads as required considering the individual emergency scenario		—	—	—	—	—	X	X	—

Loads due to stowage of the OPTS	Note 14	—	—	—	—	X	—	—	—

Note *1*:

'X' = Applicable

'—' = Not applicable

Note *2*: Applicable in case personnel handling occurs together with cargo handling on the gangway.

Note *3*: *See Ch 1, 3.2 Dead load*.

Note *4*: *See Ch 1, 3.3 Safe Working Load*, *Ch 1, 3.4 Uniformly Distributed Load*, *Ch 1, 3.5 Loads on floorings*, *Ch 1, 3.6 Loads on platforms and walkways* and *Ch 1, 3.7 Loads on handrails*.

Note *5*: *See Ch 1, 3.3 Safe Working Load*.

Note *6*: *See Ch 1, 13.1 Testing*.

Note *7*: *See Ch 1, 3.11 Mothership motions and accelerations*.

Note *8*: *See Ch 1, 3.12 Static inclinations*.

Note *9*: *See Ch 1, 3.13 Dynamic forces due to travelling, slewing, telescoping and luffing*.

Note *10*: *See Ch 1, 10 Risk assessment* and *Ch 1, 3.22 Special loads*.

Note *11*: *See Ch 1, 3.17 Snow and ice*, *Ch 1, 3.18 Temperature effects*, *Ch 1, 3.20 System internal forces*, *Ch 1, 3.21 Contact loads* and *Ch 1, 3.22 Special loads*.

Note *12*: *See Ch 1, 3.14 Wind*.

Note *13*: *See Ch 1, 3.16 Emergency scenarios and loads*, *Ch 1, 10 Risk assessment* and *Ch 1, 3.22 Special loads*.

Note *14*: *See Ch 1, 3.15 Stowage*.

4.6 Stress factors

4.6.1 The stress factor, *F*, used to determine e.g. the allowable stresses, shall be as per *Table 1.4.2 Stress factors for the defined load cases*.

Table 1.4.2 Stress factors for the defined load cases

Load case	Case 1a/1b	Case 2a/2b	Case 3	Case 4a/4b/4c
	In-Service (operation)		Out-of-Service (stowage/ survival)	In-Service or Out-of-Service (emergency/ exceptional)
Stress factor	0,67	0,75	0,85	

4.6.2 Alternatively, the concept of load and resistance factor design may be applied. The partial safety factors for the loads and the combination of loads are to be agreed with LR. The partial safety factor for the resistance side shall be taken as γ_m = 1,10. *See Ch 1, 5.1 General 5.1.2*.

4.7 Load case combinations

4.7.1 The combinations of loads and load combination cases are given in *Table 1.4.1 Conditions, configurations, effects and load types*. The combinations given shall be used even if the concept of load and resistance factor design is not applied.

4.7.2 The risk coefficients are also to be applied as defined in *Ch 1, 3.8 Risk coefficient*.

4.8 Offshore cranes

4.8.1 If the OPTS is also used as a conventional offshore crane and/or handling of personnel in a personnel containment, then the loads and load combinations of the *Code for Lifting Appliances in a Marine Environment, July 2022* for offshore cranes are to be taken into consideration. *See Ch 4, 3 Offshore cranes* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

Section 5
Allowable stresses and safety factors

5.1 General

5.1.1 This Section defines the allowable stresses and safety factors which are required to be applied to the OPTS and its components.

5.1.2 As an alternative to the allowable stress design method as given in this Section, the concept of load and resistance factor design may be applied. *See Ch 1, 4.6 Stress factors 4.6.2* and *Table 1.4.1 Conditions, configurations, effects and load types*. The application of the concept is in general to be carried out as per the requirements of National or International Standards, such as EN 13001 *Cranes – General design*. The application of this alternative concept is to be agreed with LR prior to commencing of the project.

5.1.3 Alternative approaches to calculate the allowable stresses in this Section will be specially considered.

5.2 Allowable stresses – Elastic failure

5.2.1 The allowable stresses are to be calculated as per the requirements of *Ch 4, 2.17 Allowable stress – Elastic failure* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

5.2.2 For the foundation and pedestal structure the allowable stresses shall be calculated as per *Ch 4, 5.3 Allowable stresses* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

5.3 Allowable stresses – Compression, torsional and bending members

5.3.1 The allowable stresses for compression, torsional and bending members are to be calculated as per the requirements of *Ch 4, 2.18 Allowable stress – Compression, torsional and bending members* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

5.3.2 For the foundation and pedestal structure the stress factors as given in *Ch 4, 5.3 Allowable stresses* of the *Code for Lifting Appliances in a Marine Environment, July 2022* shall be applied.

5.4 Overall stability

5.4.1 The gangway structure and other similar slender items are to be assessed for overall (buckling) stability as per the requirements of *Ch 4, 2.19 Crane jibs – Overall stability* of the *Code for Lifting Appliances in a Marine Environment, July 2022*, as applicable.

5.4.2 For the foundation and pedestal structure the stress factors as given in *Ch 4, 5.3 Allowable stresses* of the *Code for Lifting Appliances in a Marine Environment, July 2022* shall be applied.

5.5 Allowable stresses – Plate buckling failure

5.5.1 The allowable stresses for plate buckling are to be calculated as per the requirements of *Ch 4, 2.21 Allowable stress – Plate buckling failure* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

5.5.2 For the foundation and pedestal structure the stress factors as given in *Ch 4, 5.3 Allowable stresses* of the *Code for Lifting Appliances in a Marine Environment, July 2022* shall be applied.

5.6 Allowable stresses – Buckling failure of thin walled cylinders

5.6.1 The allowable stresses for plate buckling of thin walled cylinders are to be calculated as per the requirements of *Ch 4, 2.22 Allowable stress – Buckling failure of thin walled cylinders* of the *Code for Lifting Appliances in a Marine Environment, July 2022*

5.6.2 For the foundation and pedestal structure the stress factors as given in *Ch 4, 5.3 Allowable stresses* of the *Code for Lifting Appliances in a Marine Environment, July 2022* shall be applied.

5.7 Allowable stresses – Joints and connections

5.7.1 The allowable stresses for welded joints and bolted connections are to be calculated as per the requirements of *Ch 4, 2.23 Allowable stress – Joints and connections* of the *Code for Lifting Appliances in a Marine Environment, July 2022*

5.7.2 For the foundation and pedestal structure the stress factors as given in *Ch 4, 5.3 Allowable stresses* of the *Code for Lifting Appliances in a Marine Environment, July 2022* shall be applied.

5.8 Rope safety factors

5.8.1 For ST-A, ST-P, ST-H system types the rope safety factors for in-service situations are to be calculated as per the requirements in *Ch 4, 2.26 Rope safety factors and sheave ratio* or *Ch 4, 3.9 Rope safety factors* of the *Code for Lifting Appliances in a Marine Environment, July 2022* (as applicable) and these safety factors shall be a minimum of six. For the evaluation of the rope safety factor as per *Ch 4, 3.9 Rope safety factors* of the *Code for Lifting Appliances in a Marine Environment, July 2022* and in the absence of a hoisting factor for OPTS the factor F_h shall be defined as follows:

$$F_h = 1 + \frac{\text{accelerations due to mothership motions and OPTS movements}}{g}$$

5.8.2 The safety factor as defined in *Ch 1, 5.8 Rope safety factors 5.8.1* shall further be multiplied by a risk coefficient of $\gamma_{n.WR}$ = 1,6. The nominal wire rope forces shall be evaluated by applying a risk coefficient of $\gamma_{n.DW}$ = 1,1 to the dead load.

5.8.3 The rope safety factors for Case 3 or 4 situations may be calculated as per the requirements in *Ch 4, 2.26 Rope safety factors and sheave ratio 2.26.1* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

5.8.4 For ST-C system types, where the OPTS is also used as a conventional offshore crane without personnel handling, the rope safety factor is to be evaluated as per *Ch 4, 3.9 Rope safety factors* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

5.8.5 For ST-M systems types (*see Ch 1, 2.2 System types 2.2.6*), where the OPTS is used as an offshore crane with personnel handling capability (using falls and a winch), the rope safety factor is to be evaluated as per *Ch 4, 6 Handling of personnel* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

5.8.6 Where the reeving system provides some degree of redundancy the rope safety factors will be specially considered.

5.9 Friction effects

5.9.1 Friction effects of sheaves and ropes are to be taken into account as per the requirements given in *Ch 4, 2.26 Rope safety factors and sheave ratio 2.26.4* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

5.9.2 Other friction effects shall also be considered (e.g. sliding telescopic gangways).

5.9.3 The actual situation, given design and the most unfavourable environmental conditions shall be considered for the evaluation of the friction coefficients (i.e. the effects of fluids, moisture, grease, oil, etc.). The friction coefficients shall be evaluated with the lowest and highest possible friction coefficient in cases where the integrity of the design depends on the friction coefficient values.

5.9.4 The most unfavourable friction coefficient shall be applied in the design calculations. It shall be noted that unfavourable coefficients can be the highest or lowest value. The safety factor for the application of the most unfavourable friction coefficient shall be 1,5.

5.10 Limit of displacements

5.10.1 The system displacements during overload testing shall be limited as per *Table 1.5.1 Displacements limits*. The given displacement limits are related to deformation of all structural items of the OPTS from pedestal to gangway tip. Displacement limits for other materials, such as aluminium and composites, will be specially considered.

Table 1.5.1 Displacements limits

OPTS support configuration	Primary components, steel
Cantilever	$\delta_{CS.max} = \frac{L}{100}$
Both ends simply supported	$\delta_{BES.S.max} = \frac{L}{200}$

5.10.2 If the specific design of the OPTS, including the interaction with the target unit and structure, requires lower displacements, the displacements in *Table 1.5.1 Displacements limits* shall be reduced as per the requirements of the designer/manufacturer.

5.10.3 For the calculation of the system displacements in the various configurations the risk coefficient is not required to be applied. The test loads to be considered are defined in *Ch 1, 13.1 Testing*.

5.10.4 Proposals for the application of higher displacements will be specially considered if it can be demonstrated that those displacements will not result in situations which impair the usability of the system or which have an impact on the safety of the personnel to be transferred or any person close to the OPTS including the Operator.

5.11 Fatigue design assessment

5.11.1 Fatigue calculations are to be carried out in accordance with a recognised National or International Standard (e.g. ISO 20332 *Cranes – Proof of competence of steel structures*, EN 13001 *Cranes – General design*). Other standards will be specially considered. The applied standard shall be agreed with LR.

5.11.2 For these calculations a realistic load collective taking into account all significant in-service and out-of-service loads and conditions shall be applied.

5.11.3 The lifetime applied for the fatigue assessment shall not be less than the specified life time of the OPTS.

5.11.4 The proof of fatigue strength shall be carried out for each critical and primary structural component of the OPTS and the fatigue strength specific resistance factors γ_{mf} (as required in ISO 20332 *Cranes – Proof of competence of steel structures* or EN 13001 *Cranes – General design*) shall be at least taken as those provided in *Table 1.5.2 Fatigue strength specific resistance factor γ_{mf}*.

Table 1.5.2 Fatigue strength specific resistance factor γ_{mf}

Accessibility	Fatigue strength specific resistance factor γ_{mf}
Locations readily available for inspection	1,2
Locations not readily available for inspection	1,25

5.11.5 The risk coefficients as defined in *Ch 1, 3.8 Risk coefficient* are required to be applied in the proof of fatigue strength.

■ *Section 6*
Fittings, loose gear and ropes

6.1 General

6.1.1 This Section defines the requirements for fittings, loose gear and ropes which may be used in combination with OPTS and their components.

6.1.2 In general, all requirements as provided in *Ch 8 Fittings, Loose Gear and Ropes* of the *Code for Lifting Appliances in a Marine Environment, July 2022* are applicable to OPTS. Additional requirements are given in this Section.

6.1.3 All fittings and items of loose gear which are in the main load path of the OPTS supporting personnel shall be selected, taking into account the loading requirements of this Code. The design loads shall be calculated as per the requirements of *Ch 1, 3 Loads and factors* and *Ch 1, 4 Load cases and load combinations* with the exception of the application of the risk coefficients as defined in *Ch 1, 3.8 Risk coefficient*. The risk coefficient for fittings and loose gear is to be taken as $\gamma_{n.LG} = 1,6$.

6.2 Fittings

6.2.1 Fittings, as detailed in *Ch 8, 2 Fittings* of the *Code for Lifting Appliances in a Marine Environment, July 2022*, are usually used in derrick systems as per *Ch 2 Derrick Systems* of the *Code for Lifting Appliances in a Marine Environment, July 2022* and are not usually used in the design of OPTS. If it is intended to apply fittings as defined in *Ch 8, 2 Fittings* of the *Code for Lifting Appliances in a Marine Environment, July 2022*, details are to be submitted for examination.

6.2.2 The risk coefficient $\gamma_{n.LG}$ shall be applied to enhance the required nominal size of the fitting.

6.3 Blocks and hook blocks

6.3.1 Blocks including hook blocks, if applied in the design of the OPTS, are to be designed in accordance with the requirements given in *Ch 8, 3 Blocks* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. Alternatively, blocks are to be designed as per the requirements of a recognised National or International Standard.

6.3.2 The risk coefficient $\gamma_{n.LG}$ shall be applied to enhance the required nominal size of the fitting. The risk coefficient $\gamma_{n.LG}$ shall be applied to enhance the required nominal size of the block.

6.4 Spreaders and lifting beams

6.4.1 Spreaders and lifting beams, if applied in the design of the OPTS, are to be designed in accordance with the requirements given in *Ch 8, 4 Spreaders and lifting beams* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. Alternatively, spreaders and lifting beams are to be designed as per the requirements of a recognised National or International Standard.

6.4.2 The risk coefficient $\gamma_{n.LG}$ shall be applied to enhance the required nominal size of the spreader or lifting beam.

6.4.3 Reference is made to *Ch 8, 4.2 Loading and allowable stress 4.2.2* of the *Code for Lifting Appliances in a Marine Environment, July 2022* for spreaders and lifting beams that will be used in open-sea, offshore or in conditions where there is significant dynamic loading.

6.5 Loose gear

6.5.1 The safety factors as defined in the following for items of loose gear are only applicable where those items are directly engaged in the main load path for lifting or supporting of personnel. In the cases of cargo or other load handling, the safety factors are to be taken as defined in the related sections of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

6.5.2 Loose gear items, in general, are to have a safety factor of $\gamma_{n.LG} \times 6$ against the ultimate tensile strength of the materials used.

6.5.3 The hook and hook block are to comply with the requirements of *Ch 8, 3.5 Hook blocks* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. With respect to *Ch 8, 3.5 Hook blocks 3.5.1.(a)* of the *Code for Lifting Appliances in a Marine Environment, July 2022* the required safety factor against the ultimate tensile strength is generally set to $\gamma_{n.LG} \times 6$. With respect to *Ch 8, 3.5 Hook blocks 3.5.1.(b)* of the *Code for Lifting Appliances in a Marine Environment, July 2022* the risk coefficient $\gamma_{n.LG}$ shall be applied to the dead load and SWL.

6.5.4 Hooks, if applied in the design of the OPTS, are to be designed in accordance with the requirements given in *Ch 8, 5.2 Hooks* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. Alternatively, hooks are to be designed as per the requirements of a recognised National or International Standard. In addition, the following requirements are to be complied with:

(a) Hooks are to be designed for the purpose of handling personnel and the designer/manufacturer of the hooks shall specify that the hooks are suitable for the purposes of handling personnel.
(b) Hooks engaged in the handling of personnel are to be forged.
(c) Hooks shall incorporate a means to prevent inadvertent opening or other accidental loss of the load. The arrangement shall be submitted for consideration and the effectiveness shall be demonstrated to the attending Surveyor.

6.5.5 Shackles, if applied in the design of the OPTS, are to be designed in accordance with the requirements given in *Ch 8, 5.1 Shackles* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. Alternatively, shackles are to be designed as per the requirements of a recognised National or International Standard including the application of the risk coefficient $\gamma_{n.LG}$.

6.5.6 Swivels and lifting eyes, if applied in the design of the OPTS, are to be designed in accordance with the requirements given in *Ch 8, 5.3 Swivels and lifting eyes* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. Alternatively, swivels and lifting eyes are to be designed as per the requirements of a recognised National or International Standard including the application of the risk coefficient $\gamma_{n.LG}$.

6.5.7 Chains, links and rings, if applied in the design of the OPTS, are to be designed in accordance with the requirements given in *Ch 8, 5.4 Chains, links and rings* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. Alternatively, chains, links and rings are to be designed as per the requirements of a recognised National or International Standard including the application of the risk coefficient $\gamma_{n.LG}$.

6.5.8 All other items of loose gear will be specially considered on the basis of the requirements of *Ch 8, 5 Loose gear* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

6.6 Ropes

6.6.1 Steel wire ropes are to be designed in accordance with the requirements of *Ch 8, 6 Steel wire ropes* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. For the evaluation of the required minimum breaking load the risk coefficient $\gamma_{n.WR}$ (and $\gamma_{n.DW}$ respectively), shall be applied as defined in *Ch 1, 5.8 Rope safety factors*.

6.6.2 The application of fibre ropes will be specially considered. *See also Ch 8, 7 Fibre ropes* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

Section 7
Machinery

7.1 General

7.1.1 The requirements of *Ch 9 Machinery* of the *Code for Lifting Appliances in a Marine Environment, July 2022* are, in general, applicable to machinery items of OPTS unless otherwise stated in this Section. Proposals to deviate from these requirements will be specially considered.

7.1.2 Any single point failure of any machinery component and equipment shall not result in uncontrolled motions of the OPTS. *See also Ch 1, 8.16 Redundancy of components*.

7.1.3 Materials for machinery items are to be in compliance with *Ch 9, 2.2 Materials* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

7.1.4 Fatigue calculations of machinery items are to be carried out in accordance with a recognised National or International Standard (e.g. EN 13001 *Cranes – General design*, ISO 6336 *Calculation of load capacity of spur and helical gears*). Other standards will be specially considered. The applied standard shall be agreed with LR.

7.1.5 Testing of machinery is to be carried out as per the requirements of *Ch 1, 13.1 Testing*.

7.2 Winches

7.2.1 Winches and their components are to be in compliance with *Ch 9, 3 Mechanical design requirements* and *Ch 9, 4 Machinery engaged in handling of personnel* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

7.3 Gears and gearboxes

7.3.1 Gears and gearboxes are to be in compliance with *Ch 9, 3 Mechanical design requirements* and *Ch 9, 4 Machinery engaged in handling of personnel* of the *Code for Lifting Appliances in a Marine Environment*.

7.4 Linear actuators

7.4.1 Linear actuators shall be designed in compliance with *Ch 4 Cranes and Submersible Lifting Appliances*, *Ch 9 Machinery* and *Ch 10 Electrotechnical Systems* of the *Code for Lifting Appliances in a Marine Environment, July 2022* (as applicable) or a recognised National or International Standard.

7.4.2 Linear actuators are, in the following, to be understood as hydraulically, pneumatically or electrically driven actuators, either by internal pressure or rotating motors.

7.4.3 Linear actuators, which contain a lead screw to arrange for axial movement of the rod, are to be considered for buckling both on the entire extended actuator and the lead screw part only.

7.4.4 Linear actuators are to be fitted with end stops sufficient to withstand the kinetic energy from both the moving and rotating parts as applicable.

7.4.5 Lead screws with bronze or plastic nuts are to have a facility to protect the load from being dropped due to excessive wear of the bronze or plastic nut and/or the lead screw and are to have an arrangement to lubricate the lead screw and the nut.

7.4.6 Linear actuators which are fitted on deck are to be sufficiently protected from environmental effects such as green sea.

7.4.7 Linear actuators shall not be subjected to loads other than axial forces, i.e. external bending moments. Other proposals will be specially considered.

7.4.8 Hydraulic cylinders are to be designed to comply with *Ch 9, 5 Hydraulic cylinders* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. Possible steel to steel contacts between any of the hydraulic cylinder components need to be taken into consideration.

7.5 Hydraulic systems

7.5.1 Mounting of the piping and the equipment shall be performed in such a way as to allow inspection along its length.

7.5.2 For motion compensated systems directly operated by hydraulic cylinders or where hydraulic cylinders are otherwise engaged in the support or transfer of persons, valves shall be fitted to prevent uncontrolled motions in case of pipe or hose failure. The system shall be designed such that, in the event of hydraulic leakage, no dangerous situation can occur.

7.5.3 The arrangements for storage, distribution and utilisation of hydraulic and flammable oils employed under pressure in power transmission systems, control and actuating systems, and hydraulic media in systems are to comply with the requirements of this Section.

7.5.4 Hydraulic power units (HPU) are to deliver hydraulic fluid under pressure for actuation of hydraulically driven machinery and for operation of remote-controlled equipment.

7.5.5 Hydraulic fluids are to be suitable for the intended purpose under all operating service conditions.

7.5.6 The hydraulic system shall be provided with arrangements to maintain the cleanliness of the hydraulic fluid taking into consideration the type and design of the hydraulic system.

7.5.7 Materials used for all parts of hydraulic seals are to be compatible with the working fluid at the appropriate working temperature and pressure.

7.5.8 The OPTS hydraulic power actuating systems shall be independent of the ship's hydraulic systems.

7.5.9 Piping shall be supported so that undue stresses are eliminated. Particular attention shall be paid to joints, bends and fittings, and at any section of the system subject to vibration. Protection is to be provided at locations of enhanced risk of external impact.

7.5.10 Pressure hoses shall be able to withstand four times the maximum design pressure. Hydraulic hoses shall be suitable for the type of hydraulic fluid used in the system.

7.5.11 Hoses shall be installed so as to prevent sharp bends and chafing or trapping due to moving parts of the machine.

7.5.12 The manufacturer shall specify the intervals at which the hoses should be replaced.

7.5.13 Supply piping to hydraulic power actuating systems are to be as short as practicable.

7.5.14 The use of flexible hoses is to be restricted to positions where it is necessary to accommodate relative movement between items of equipment and fixed pipe-work.

7.5.15 Where a hydraulic securing is applied, the system is to be capable of being mechanically locked in the closed position so that, in the event of hydraulic system failure, the securing arrangements will remain locked.

7.6 Hydraulic fluid storage

7.6.1 Tanks and reservoirs for service and the storage of hydraulic fluids are to be made of steel and suitable for the maximum head of fluid to which the tanks may be subjected. In general, tanks are to have a minimum plate thickness of 5 mm, but in the case of very small tanks, the minimum thickness may be 3 mm.

7.6.2 The storage capacity for hydraulic fluids is to be sufficient to recharge the largest system on board plus normal usage during a typical mission. Storage capacity is to be sufficient for each type of hydraulic fluid used. Storage capability sufficient to handle the full capacity of the largest hydraulic system on board is also to be provided for contaminated hydraulic fluids.

7.6.3 Tanks and reservoirs are to be provided with two connections at diagonally opposite corners, one top and one bottom, to permit the contents to be circulated through portable flushing equipment.

7.6.4 The capacity of hydraulic fluid reservoirs at normal working level is to ensure a residence time for the fluid of not less than 3 minutes.

7.6.5 A vertical baffle plate is to be fitted dividing each reservoir into two compartments interconnected at the top of the baffle. Return fluid, drains, etc. are to be made to one side of the baffle whilst pump suctions are to be taken from the other side.

7.6.6 All tanks and reservoirs are to be provided with approved means of hydraulic fluid level indication.

7.6.7 Tanks which are required to provide heat dissipation from the hydraulic system shall be provided with temperature indication.

7.6.8 All tanks and reservoirs are to be provided with approved means of sampling the contents and a means of access for cleaning.

7.6.9 All tanks are to be fitted with a deaeration capacity of not less than 125 per cent of all the power pumps connected which may run simultaneously.

7.6.10 All tanks are to be designed such that all pump suctions remain below the lowest set oil level for all design trim and conditions.

7.7 Pump units

7.7.1 Two or more hydraulic pumps are to be provided for each power actuating system. Each pump is to be of sufficient capacity to supply the system under defined operational requirements stated in the system design description.

7.7.2 All hydraulic pumps are to be provided with relief valves. Each relief valve is to be in a closed circuit, i.e. arranged to discharge back to the suction side of the pump and effectively to limit the pump discharge pressure to the design pressure of the system. The relief valve set pressure is to be not less than 125 per cent of the maximum anticipated working pressure to prevent loss of movement/functionality during discharging.

7.7.3 Where pump units are provided with accumulators, a shut-off valve is to be provided between the pressure line and the accumulator with a bleed valve fitted between the shut-off valve and the accumulator.

7.7.4 Where accumulators are provided with gas pressurisation, isolating valves are to be fitted in the gas lines at each accumulator. A relief valve is to be fitted in the gas supply line to prevent the gas supply line and the accumulator being pressurised above its maximum working pressure.

7.8 Cooling arrangements

7.8.1 Cooling arrangements for hydraulic fluids are to be provided where the operating temperature of the fluid may exceed the maximum design temperature limitations of the fluid or equipment in the system as defined in the system design description.

7.8.2 Where the provision of cooling arrangements is necessary to maintain hydraulic fluid temperatures, not less than two means of cooling are to be provided and configured such as to provide cooling with one means out of action.

7.9 Pipes conveying hydraulic fluid

7.9.1 Piping systems for flammable hydraulic fluids are to be installed to avoid fluid spray or leakage onto hot surfaces, into machinery air intakes, or onto other sources of ignition such as electrical equipment. Pipe joints are to be kept to a minimum, and where provided are to be of a type, acceptable to LR. Pipes are to be led in well lit and readily visible positions.

7.9.2 Pipes conveying hydraulic oil under pressure are to be of seamless steel or other approved material having flanged or welded joints and are to be placed in clearly visible and readily accessible locations. The number of flanged joints is to be kept to a minimum.

7.9.3 The design of filter and strainer arrangements is to be such as to avoid the possibility of them being opened inadvertently when under pressure. This may be achieved either by mechanically preventing the pressurised filter from being opened or by providing pressure gauges which clearly indicate which filter is under pressure. In either case, suitable means for pressure release are to be provided, with drain pipes led to a safe location.

7.9.4 Pressure equipment, such as pressure vessels, bladder accumulators and nitrogen bottles, is to comply with *Pt 5, Ch 11 Other Pressure Vessels* of the *Rules and Regulations for the Classification of Ships, July 2022*.

7.9.5 Pressure piping systems are to be in compliance with *Pt 5, Ch 12 Piping Design Requirements* of the *Rules and Regulations for the Classification of Ships, July 2022*.

7.10 Other components

7.10.1 Bearings are to be in compliance with *Ch 9, 3.10 Bearings* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

7.10.2 Slewing rings are to be in compliance with *Ch 4, 3.7 Slew rings* and *Ch 9, 3.11 Slewing rings* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

7.11 Reeving system

7.11.1 If the design of the OPTS requires a rope reeving system, the requirements in this Section shall be complied with.

7.11.2 The sheaves shall be designed to comply with *Ch 8, 3.3 Materials and construction* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. If the reeving system is involved in the motion compensation, then the diameter of the sheave will be specially considered.

7.11.3 The friction effects in the reeving system need to be taken into account, *see Ch 4, 2.26 Rope safety factors and sheave ratio 2.26.4* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

7.11.4 The reeving system requires a slack rope detection and prevention system.

7.11.5 The reeving system is to be designed with due consideration of the effects of fatigue on the wire rope (e.g. avoidance of reverse bends).

7.12 Brakes

7.12.1 Brakes are to be in compliance with the applicable requirements of *Ch 9, 3 Mechanical design requirements* and *Ch 9, 4 Machinery engaged in handling of personnel* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

7.12.2 Any deviation from the application of the requirements for brakes (as outlined in *Ch 1, 7.12 Brakes 7.12.1*) for ST-P, ST-A and ST-H system types will be specially considered.

7.13 Mechanical limiting devices (end stops)

7.13.1 Passive and active OPTS (ST-P, ST-A and ST-H) are to be provided with mechanical limiting devices which prevent exceeding the geometrical limits of all moving components and motions of the OTPS. A minimum of the following mechanical limits shall be foreseen in the design:

(a) telescoping system;
(b) luffing system;
(c) slewing system, in case the slewing angle is required to be limited;
(d) hydraulic cylinders; and
(e) electro-mechanical actuators.

7.13.2 The arrival at the mechanical limits shall not result in a dangerous situation for the transferring personnel, the OPTS, the mothership or the target unit/structure.

7.13.3 The mechanical limiting devices are to be designed to withstand the maximum forces resulting from a single point failure.

7.13.4 The telescoping and luffing motion shall also be limited by a mechanical end stop in addition to the limit switches.

7.13.5 In case the slewing motion is required to be limited, a mechanical end stop shall be provided in addition to the limit switches.

■ *Section 8*
Functional requirements

8.1 General

8.1.1 This Section covers the basic functional requirements such as:

(a) location of the OPTS on the mothership;
(b) pedestals and foundation;
(c) environmental conditions;
(d) access arrangements (e.g. floorings, platforms, walkways, ladders, guards, guard-rails, handrails, stanchions, head height, gangway);
(e) gangway protection;
(f) ergonomics (e.g. Operator control station);
(g) access control arrangements;
(h) maintenance;
(i) redundancy of components;
(j) requirements for effective motion compensation;
(k) safety equipment and evacuation arrangements;
(l) motion control and limitation;
(m) personnel containment and baskets;
(n) stowage;
(o) dropped objects;
(p) fire safety;
(q) hazardous areas; and
(r) winterisation

which shall be applied to the OPTS to be classed or certified to the requirements of this Code.

8.1.2 Proposals to deviate from the requirements of this Section will be specially considered.

8.1.3 The general design principle shall be that no single point failure in any part of the OPTS will result in hazards to the personnel being transferred, the Operator or other persons near the OPTS, or personnel on the mothership or the target unit.

8.1.4 The OPTS is further to be designed to cover the significant hazards as per ISO 12100 *Safety of machinery – General principles for design – Risk assessment and risk reduction* which are not dealt with in this Code. Moving or rotating parts shall not pose a mechanical hazard (e.g. crushing, shearing, cutting, etc.) to personnel to be transferred, the Operator or other persons.

8.1.5 For the design of the gangway particular attention is drawn to the torsional stiffness of the gangway structure forming an open U-shaped cross-sectional profile which will still have some torsional resistance. Such resistance can lead to external and internal forces which need to be considered.

8.2 Location

8.2.1 The OPTS should be located clear of any working area unrelated to the personnel transfer operations.

8.2.2 The OPTS is not to be placed where cargo or other suspended loads may pass overhead of any configuration of the OPTS. However, if this cannot be avoided by design, it shall be ensured that personnel transfer operations are not conducted, and personnel are not on or near the OPTS at those times of operation.

8.3 Pedestals and foundation

8.3.1 Pedestals and their foundation are to be designed as per *Ch 4, 5 Pedestals and foundation* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

8.3.2 Where bolted connections are applied to connect the OPTS pedestal/foundation with the mothership structure, those bolted connections are to be designed to 75 per cent of the individual yield stress factors given in *Ch 4 Cranes and Submersible Lifting Appliances Table 4.2.14 Allowable stresses for fitted bolts* and *Table 4.2.15 Allowable stresses for non-fitted bolts* in the *Code for Lifting Appliances in a Marine Environment, July 2022*.

8.4 Environmental conditions

8.4.1 Hazards affecting the OPTS or its components and parts, originating from temperature effects, shall be taken into consideration. Reference is made to *Ch 1, 10 Risk assessment*.

8.5 Floorings

8.5.1 Floorings shall be designed in compliance with a recognised National or International Standard (e.g. ISO 14122 *Safety of machinery – Permanent means of access to machinery*). In addition, the following requirements shall be considered and in case of conflict the more onerous requirement shall apply.

8.5.2 The surface of all floorings shall be supplied with non-slip material and/or surface. The slip-resistance shall be maintained when the flooring is wet or otherwise contaminated with substances reducing the friction coefficient.

8.5.3 The means of connection between the flooring structure and the gangways, walkways, waiting areas or similar structure shall avoid loosening and shall not pose a tripping hazard.

8.5.4 The gaps between the flooring components shall be small enough to prevent tripping and dropped objects. For guidance the gaps shall not be larger than the grating grid spacing, but less than 20 mm by 20 mm in any case.

8.5.5 The individual flooring segments shall be arranged at an equal surface level. To avoid unequal flooring levels the individual consecutive segments shall preferably be placed on a common support structure. The difference in elevation of the individual flooring segments shall be a maximum of 4 mm.

8.5.6 The area below the flooring shall be secured against dropped objects falling through grating flooring structures. Alternatively, sufficiently small grating mesh sizes shall be chosen, but less than 20 mm by 20 mm in any case.

8.5.7 The flooring structure shall be protected against corrosion, or other degradation in the case of non-metallic materials.

8.5.8 The design loads for floorings are provided in *Ch 1, 3.5 Loads on floorings*.

8.6 Platforms and walkways

8.6.1 Platforms and walkways and similar arrangements shall be designed in compliance with a recognised National or International Standard (e.g. ISO 14122 *Safety of machinery – Permanent means of access to machinery*). In addition, the following requirements shall be considered and in case of conflict the more onerous requirement shall be applied.

8.6.2 For the purposes of these requirements waiting areas (if applicable) are considered as a sub-category of a platform or walkway.

8.6.3 The floorings of platforms and walkways shall be designed as defined in *Ch 1, 8.5 Floorings*.

8.6.4 Platforms and walkways shall not be inclined. If an inclined walkway cannot be avoided due to design restrictions the inclination angle shall be limited to ±5°.

8.6.5 The minimum effective width of walkways shall be 600 mm.

8.6.6 The minimum area for each person in the waiting area shall be 0,25 m^2.

8.6.7 Interface areas need to be designed in such a way to ensure that there will be no hazards for personnel due to relatively moving parts (e.g. crushing or shearing of body extremities such as feet and hands, etc.). Any deflections causing gaps between interface areas need to be taken into consideration in the design. Each interface area shall be marked with a warning pattern in black and reflecting yellow.

8.6.8 Platforms and walkways shall be enclosed by guard rails. The guard rails shall be equipped with means to avoid dropped objects from falling through the guard rails and their supporting structure. In case access through the guard rails is required a gate shall be fitted. Reference is made to *Ch 1, 8.9 Guard rails, handrails and stanchions*.

8.6.9 Where platforms and walkways can only be accessed via a ladder, means are to be provided to close the opening in the guard rails with a gate or similar means.

8.6.10 The design loads for platforms and walkways are provided in *Ch 1, 3.6 Loads on platforms and walkways*.

8.7 Ladders

8.7.1 Ladders shall be designed in compliance with a recognised National or International Standard and EN 13586 *Cranes – Access* or ISO 14122 *Safety of machinery – Permanent means of access to machinery* shall be considered to be applied (as applicable).

8.8 Guards

8.8.1 Guards shall be designed in compliance with a recognised National or International Standard and ISO 14120 *Safety of machinery – Guards – General requirements for the design and construction of fixed and movable guards* shall be considered to be applied (as applicable).

8.9 Guard rails, handrails and stanchions

8.9.1 Guard rails, handrails, stanchions, and similar arrangements shall be designed in compliance with a recognised National or International Standard (e.g. ISO 14122 *Safety of machinery – Permanent means of access to machinery*). In addition, the following requirements shall be considered and in case of conflict the more onerous requirement shall be applied.

8.9.2 Handrails shall be made of continuous rigid solid or hollow sections. The handrail material shall be metal, but other materials will be specially considered.

8.9.3 Guard rails, stanchions or similar side supporting structures are to be permanently connected to the gangway or walkway structure. Stanchions shall be fitted in equal distances of a maximum of 1500 mm. Smaller distances may need to be applied in order to fulfil the requirements as stipulated in *Ch 1, 8.9 Guard rails, handrails and stanchions 8.9.1* and *Ch 1, 8.9 Guard rails, handrails and stanchions 8.9.2*.

8.9.4 The minimum height of the handrail or top guard rail above flooring level for gangways, walkways and waiting area shall be 1100 mm. There shall be at least two intermediate guard rails (or similarly effective arrangements) provided between the top guard rail and the flooring, each being not more than 380 mm apart. The distance from the top of the toe plate to the lowest guard rail shall not be more than 230 mm. The height of the top guard rail may need to be increased as a result of the risk assessment (e.g. in case of significant lateral or vertical accelerations posing a hazard to personnel). In case of a top guard rail height above 1100 mm, additional intermediate guard rails shall be provided with a maximum spacing of 380 mm. In case of a top guard rail height above 1100 mm, a handrail is to be provided at a height between 900 mm and 1100 mm. Rails which are used as a handrail are to be uninterrupted and easy to grasp.

8.9.5 Toe plates with a minimum height of 100 mm are to be fitted in way of steps and walkways.

8.9.6 The design loads for walkways are provided in *Ch 1, 3.7 Loads on handrails*.

8.9.7 Gates shall be designed in compliance with a recognised National or International Standard (e.g. ISO 14122 *Safety of machinery – Permanent means of access to machinery*). In addition, gates shall be provided with a self-locking device that will restrain the gate from accidental opening.

8.10 Head height

8.10.1 The minimum head height over platforms, walkways and gangways shall be 2100 mm.

8.10.2 The head height shall not be reduced due to obstacles in way of platforms, walkways and gangways, such as gaps between interfaces.

8.11 Gangway

8.11.1 The gangway shall be designed in compliance with a recognised National or International Standard and ISO 5488 *Ships and marine technology – Accommodation ladders* and ISO 7061 *Ships and marine technology – Aluminium shore gangways for seagoing vessels* shall be considered to be applied (as applicable). In case of conflict between an applied recognised National or International Standard the requirements of this Code shall be applied.

8.11.2 The minimum effective width of the gangway shall be 600 mm for A-GR and 1200 mm for A-GU type systems.

8.11.3 Interface areas need to be designed in such a way to ensure that there will be no hazards for personnel due to relatively moving parts (e.g. crushing or shearing of body extremities such as feet and hands, etc.). Interface areas include, but are not limited to:

(a) Between the OPTS base frame and the motion compensation and/or pedestal;
(b) within the motion compensation system;
(c) between the gangway and the OPTS base frame;
(d) between the main and telescopic part of the gangway (if any);
(e) between the gangway tip and the target structure; or
(f) between other similar interface areas of relatively moving parts.

Any deflections causing gaps between interface areas need to be taken into consideration in the design. Each interface area shall be marked with a warning pattern in black and reflecting yellow.

8.11.4 Gaps between gangway and base frame, between the main and telescopic part of the gangway, between the gangway tip and the target structure or similar arrangements posing a hazard of falling through, need to be secured by means of structural barriers such as guard rails.

8.11.5 The design of areas of moving parts (e.g. luffing or telescoping hydraulic cylinders) needs to ensure that hazards for personnel are prevented.

8.11.6 Protruding parts in way of walkways, waiting areas or similar arrangements, which may result in tripping or other hazards, shall be avoided by design. Alternative solutions by means of marking will be specially considered.

8.11.7 The side supporting structure shall be equipped with means preventing objects from falling from the gangway, such as safety nets or similar. Such arrangements may be omitted in case of non-perforated structural designs (e.g. side plating) instead of a lattice structure.

8.11.8 Hydraulic piping and/or hoses need to be secured to avoid accidental damage by personnel or cargo trolleys moving along the gangway.

8.11.9 The design of rope reeving arrangements needs to ensure that hazards for personnel due to running ropes or turning sheaves are avoided.

8.11.10 During the personnel transfer operation the preferred angle of the gangway relative to the horizontal plane shall be within +10° and -10°. The maximum personnel transfer operation gangway inclination shall be limited to be within +20° and -20°. The application of other personnel transfer operation gangway angles will be specially considered.

8.11.11 The gangway may be subjected to larger angles while not operating in personnel transfer mode, e.g. in case the system is also used as a conventional offshore crane (e.g. ST-C type systems). In such cases the simultaneous use of the personnel transfer mode and the offshore crane mode shall be prohibited.

8.12 Gangway protection

8.12.1 The OPTS shall be equipped with a lateral gangway protection system ensuring that the design sideways forces are not exceeded during active slewing operations.

8.12.2 The OPTS shall be equipped with a vertical gangway protection system ensuring that the design forces are not exceeded during active luffing operations.

8.12.3 Active motion compensation systems which are controlling the motions of the gangway and the contact forces between the gangway tip and the target structure may be regarded as being equipped with a gangway protection system.

8.12.4 OPTS which are in free floating mode may be regarded as being equipped with a gangway protection system as long as there are warnings when the system is approaching its limits.

8.13 Operator control station

8.13.1 The OPTS is required to include a dedicated Operator control station which shall comply with the requirements of a recognised National or International Standard and the application of EN 13557 *Cranes - Controls and control stations* shall be considered (as applicable).

8.13.2 If the Operator control station is provided inside an Operator's cabin, the Operator shall be protected from the environmental influences as follows:

(a) temperature (heat and cold);
(b) noise and vibration;
(c) direct sunlight;
(d) humidity;
(e) wind;
(f) rain;
(g) snow;
(h) ice; and
(i) other environmental influences.

The details of the required environmental protection level shall be agreed in each case.

8.13.3 The Operator's cabin, if provided, shall further:

(a) provide suitable space to enable the Operator to operate the OPTS;
(b) as far as practicable, be made of fire-retardant or fire-resistant materials, to a recognised Code or standard, e.g. IMO *International Code for the Application of Fire Test Procedures (2010 FTP Code)*, etc.;
(c) be suitably ventilated;
(d) enable the windows to be defrosted and defogged;
(e) have window wipers fitted enabling an unobstructed view of the walkways, gangway, gangway tip and target structure;
(f) have an ergonomically designed adjustable seat, including the arrangements of the controls (*see Ch 1, 8.13 Operator control station 8.13.7*); and
(g) be provided with an emergency means of escape in addition to the main access route.

8.13.4 The Operator cabin, if provided, shall comply with the requirements of a recognised National or International Standard and the application of EN 13557 *Cranes - Controls and control stations* shall be considered (as applicable).

8.13.5 The design of the control station shall allow the Operator to have an unobstructed view of the walkways, gangway, gangway tip and target structure.

8.13.6 The persons at the control station e.g. Operator, shall be protected from dropped objects. Further protection shall be provided at the control station to prevent persons from falling from height.

8.13.7 The main control panel shall be equipped with the following marked and illuminated controls and indicators:

(a) Start/stop of OPTS;
(b) interlock preventing the simultaneous operation of the main control panel and a remote or secondary control panel (if applicable);
(c) emergency stop;
(d) control levers for manual movement of the gangway (e.g. luffing, slewing, telescoping, vertical, horizontal, travelling motions – all as applicable);
(e) access control;
(f) emergency opening of access control (if applicable);
(g) switch to disable/enable motion compensation;
(h) dead man switches (only required in case of single Operator ST-A and ST-H systems);
(i) indication of whether the system is within operational design limits (including a display of trends);
(j) display of alerts using appropriate visual indicators and audible signals (*see Ch 1, 9.4 Active systems (ST-A or ST-H) 9.4.7*);
(k) crane related controls, indicators, switches and information (if applicable); and

(l) mode indicator in case the OPTS fulfils several different functions (e.g. ST-H and ST-C).

8.13.8 A Secondary (emergency) means of control shall be provided in cases of failure of the main control panel. The activation of the secondary means of control and the changeover of control over the OPTS shall be possible without undue delay. In case of active systems (ST-A or ST-H), the secondary means of control shall take account of the requirements of *Ch 1, 9.4 Active systems (ST-A or ST-H) 9.4.4*. Reference is further made to *Pt 6, Ch 1, 2.2 Control stations for machinery 2.2.6* and *Pt 6, Ch 1, 2.2 Control stations for machinery 2.2.7* of the *Rules and Regulations for the Classification of Ships, July 2022*.

8.13.9 In case of hydraulically driven OPTS, the control station shall be equipped with a manual hydraulic control. The manual hydraulic control may be regarded as a secondary (emergency) means of control.

8.13.10 For cableless remote-control panels reference is made to *Ch 1, 9.2 General 9.2.5*.

8.14 Access control arrangements

8.14.1 Access control arrangements are to be installed for all OPTS which are designed for a limited number of persons allowed simultaneously on the gangway or walkway.

8.14.2 If the access control system is designed as a physical barrier such as a crossing gate system an emergency means of opening needs to be implemented for each barrier at the barrier and at the control stations.

8.14.3 Reference is made to *Ch 1, 9 Electrotechnical systems*.

8.15 Maintenance

8.15.1 All parts and components of the OPTS are to be designed to allow for regular and irregular maintenance. All parts and components need to be readily accessible and if necessary, allow for all required inspection and maintenance activities, such as checking and monitoring of systems and components status, lubrication, repair and exchange of parts or components.

8.15.2 Every OPTS is to be constructed so as to reduce routine maintenance to a minimum. Those parts requiring regular maintenance are to be readily accessible and easily maintained by the mothership's crew or Operator.

8.15.3 The maintenance system shall allow the identification of any trends which may support the resolution of systematic maintenance related aspects of the OPTS.

8.15.4 The guidelines as provided in ISO 12478-1 *Cranes – Maintenance manual – Part 1: General* shall be taken into consideration.

8.15.5 For further information about the scope of thorough examination (incl. maintenance aspects) *see Table 1.13.2 6-Monthly thorough examination of OPTS*.

8.16 Redundancy of components

8.16.1 As outlined in *Ch 1, 1.1 Introduction 1.1.6*, the lifting and supporting of persons with machines in an offshore or open-sea environment is regarded as an application posing higher risks for personnel compared to normal cargo handling operations.

8.16.2 For the purposes of decreasing the probability of occurrence of harm and failure the concept of EN 13135 *Cranes – Safety – Design – Requirements for equipment*, clause 5.9 shall be applied. This can be achieved by the application of a risk coefficient or by duplication of components. The specification of an enhanced inspection and maintenance programme or an upgrade of the level of quality control alone is not considered to be sufficient as a risk reduction/mitigation measure.

8.16.3 The general principles and steps of risk reduction measures are described in ISO 12100 *Safety of machnery – General principles for design – Risk assessment and risk reduction*, clause 6.

8.16.4 The concept and application of risk coefficients is described in EN 13001-2 *Cranes – General design – Part 3-2: Limit states and proof of competence of wire ropes in reeving systems*, clause 4.3.2 and Annex D.

8.16.5 As a general principle and for safety critical components, the redundancy of components of the OPTS shall be such that no single point failure will lead to a failure of any further component, an uncontrollable situation, or uncontrolled motion of the OPTS. There shall be no hazard to any personnel in case of a single point failure.

8.16.6 Two fully redundant means of luffing shall be established in the design of the OPTS. This can be by means of two hydraulic cylinders, either one of which being capable of holding and luffing the gangway but not required to motion compensate.

8.16.7 In addition to the requirements in *Ch 1, 8.16 Redundancy of components 8.16.5* and in case only one hydraulic cylinder is proposed in the design, an enhanced risk coefficient is to be applied as follows:

(a) A-GU type systems:

$$\gamma_{n.UDL.NR} = 1 + 2(\gamma_{n.UDL} - 1)$$

$$\gamma_{n.DL.NR} = 1 + 2(\gamma_{n.DL} - 1)$$

(b) A-GR type systems:

$$\gamma_{n.SWL.NR} = 1 + 2(\gamma_{n.SWL} - 1)$$

$$\gamma_{n.DL.NR} = 1 + 2(\gamma_{n.DL} - 1)$$

For a definition of the original risk coefficients $\gamma_{n.SWL}$, $\gamma_{n.UDL}$ and $\gamma_{n.DL}$ *see Ch 1, 3.8 Risk coefficient*.

8.16.8 The risk coefficients as defined in *Ch 1, 8.16 Redundancy of components 8.16.7* shall be applied for the evaluation of the external loads acting on the hydraulic cylinder or other luffing arrangement. The extent of the application of such loads shall cover the following items:

(a) hydraulic cylinders or other luffing arrangement;
(b) pins connecting the hydraulic cylinder or other luffing arrangement to its supporting structure;
(c) directly supporting structure, such as eye-plates; and
(d) similar structure.

8.16.9 The risk coefficient shall be applied in all operational load cases.

8.16.10 The redundancy of the stowage arrangements or parts of the stowage arrangement shall also be taken into consideration in case the failure of any single part will lead to an uncontrollable release of the OPTS or any part of the OPTS.

8.16.11 A single hydraulic cylinder (including pins) and the associated hydraulic system and associated supporting structure shall be subjected to an enhanced inspection and maintenance regime.

8.16.12 The redundancy requirements for telescopic arrangements and drives will be specially considered.

8.16.13 The redundancy requirements for arrangements directly used for motion compensation will be specially considered.

8.17 Requirements for effective motion compensation

8.17.1 The motion compensation performance and/or limitations of the OPTS need to be compatible with the station keeping capability and performance (e.g. system capability plot) of the mothership DP system. For the assessment of the compatibility the following shall be considered as a minimum:

(a) Safe situation after the worst single point failure of the station keeping system/arrangement; and
(b) compensation capability of the OPTS.

8.17.2 In case a DP system is not fitted it is to be demonstrated that the motion compensation performance of the OPTS is sufficient for the intended environmental conditions.

8.17.3 In order to provide the basis for effective active motion compensation of the OPTS, the motions of the mothership and (if applicable) the motions of the target unit need to be measured and the data needs to be provided for processing by the OPTS control system. The actual motions of the OPTS shall be monitored in order to ensure that the design operating envelope of the OPTS is not exceeded during operations.

8.18 Safety equipment

8.18.1 The design of the access arrangements to the OPTS shall be such that specialist personnel protective equipment (e.g. harness) is not required.

8.18.2 Additional Flag State, Coastal State Authority, Owner or Operator requirements are to be considered.

8.19 Evacuation arrangements

8.19.1 As referenced in *Ch 1, 1.2 Scope 1.2.3*, this Code does not extend to address accidental load cases. As such, in cases where the OPTS is part of the evacuation concept of the target unit or mothership the following aspects need to be considered as a minimum:

(a) Only non-combustible materials (i.e. steel) shall be used for the main support structures and guards, guard-rails, handrails and stanchions.
(b) Only A-GU (unrestricted access) type systems shall be included in the evacuation concept.
(c) The intended position of the mothership and the planned location of the OPTS interface to the offshore installation is to be in a location outside the range of any credible accidental loads, e.g. explosion blast loads, fire, dropped objects, etc. This is

considered to require particular attention for OPTS interfaced with offshore hydrocarbon production and/or drilling installations.

8.20 Motion monitoring

8.20.1 The operational motion limits defined in *Ch 1, 8.20 Motion monitoring 8.20.3* and *Ch 1, 8.20 Motion monitoring 8.20.4* shall be applied.

8.20.2 The compensated motion shall be continuously monitored and recorded by the control system throughout the transfer operation and at least for a period of ten minutes prior to transfer operations. Operational motions are inherently statistical, therefore an appropriate statistical method shall be applied to provide for safe transfer operations. The statistical method is to determine the probability of exceeding the operational motion limits provided in *Ch 1, 8.20 Motion monitoring 8.20.3* and *Ch 1, 8.20 Motion monitoring 8.20.4*, during a representative transfer period of a minimum of ten minutes. The captured motion data shall be analysed by the control system and an alarm sounded if the probability (evaluated by the statistical model/method) of exceeding any limit is greater than $P = 10^{-3}$, to indicate that personnel transfer shall be suspended until motions are back within the defined limits. The probability level of $P = 10^{-3}$ is applied as a minimum for acceptable risk with reference to LR's ShipRight Procedure for *Risk Based Certification (RBC)*.

8.20.3 During transfer of personnel, the following acceleration limits shall be applied by the control system using an appropriate statistical control method based on the expected peak values. These limits shall apply at all points on the OPTS including the gangway:

(a) vertical acceleration: 2,0 m/s^2; and

(b) horizontal acceleration: 1,0 m/s^2.

8.20.4 During transfer of personnel, a velocity limit of 0,5 m/s shall be applied by the control system using an appropriate statistical control method based on the expected peak values. These limits shall apply at all points on the OPTS including the internal movements of the gangway, e.g. due to movement of the telescopic part of the gangway.

8.20.5 During the transition between uncompensated and compensated states the access control system shall clearly indicate that personnel transfer is not permitted.

8.20.6 Deviations from the requirements in *Ch 1, 8.20 Motion monitoring 8.20.2* to *Ch 1, 8.20 Motion monitoring 8.20.4* will be specially considered.

8.21 Personnel containment and baskets

8.21.1 Suspended baskets as part of the personnel handling functionality of the OPTS functioning as an offshore crane (*see Ch 1, 1.10 Terms and definitions 1.10.3*) shall be designed and certified for this purpose.

8.21.2 Personnel containments supporting personnel to be transferred as part of the OPTS (*see Ch 1, 1.10 Terms and definitions 1.10.38*) shall be designed for this purpose and will be assessed together with the OPTS being certified or classed.

8.21.3 Cargo baskets shall be designed to safely contain the intended objects considering the motions and loads as applicable at the intended location on the gangway (e.g. gangway motion and accelerations).

8.22 Stowage

8.22.1 The OPTS needs to be supplied with a dedicated stowage concept/arrangement for general transit/voyage and in-field transit (*see Ch 1, 4.3 General transit/voyage (stowage/survival) and in-field transit load combinations*).

8.22.2 The design of the stowage concept/arrangement shall cover the following aspects as a minimum:

(a) The gangway or personnel containment of the OPTS shall be designed to have a designated stowage position and means of securing are to be provided.

(b) The machinery systems of the OPTS shall be designed to be able to be disconnected from their power source and means of securing are to be provided.

(c) Means of stowage/securing are to be provided for all other equipment and components where there is a hazard that they may become loose during general transit/voyage or in-field transit.

8.22.3 Depending on the OPTS type and design it may be acceptable for in-field-transit that a less strict securing regime is applied. For example, it might be acceptable that the gangway is only supported by the luffing systems and the gangway slewing is arrested by drive brakes for in-field-transit cases. However, in such cases it is to be ensured that proper weather window information is obtained in order to ensure that the design loads for the system are not exceeded and/or hazardous situations, such as uncontrolled gangway movements, are avoided in all cases.

8.23 Dropped objects originating from the OPTS

8.23.1 This sub-Section refers to dropped object hazards originating from the OPTS.

8.23.2 All non-welded items need to be assessed for the risk of becoming dropped objects. Bolted connections pose a particular hazard and need to be assessed with particular attention.

8.23.3 Components, parts and equipment which are exposed to vibrations, impact or motions are to be secured in case there is a hazard that those items become dropped objects.

8.23.4 The instructions for use shall also address the hazard of objects dropped by transferring personnel, Operators and other personnel working on the OPTS. The instructions for use shall include guidance on limiting the risk of dropped objects. Examples for such dropped objects are:

(a) From transferring personnel, OPTS maintenance personnel, inspectors, Surveyors, etc:

carried tools and other objects/parts/components/spare parts, parts of the PPE, etc.

(b) From OPTS Operators:

PPE, remote controls, etc.

8.23.5 Reference is made to ANSI/ISEA 121 *American National Standard for Dropped Object Prevention Solutions* for general guidance concerning dropped objects.

8.24 Dropped and moving objects posing a hazard to the OPTS

8.24.1 This sub-Section refers to dropped and moving objects posing a hazard to the transferring personnel, the Operator and any part of the OPTS (including the control panel).

8.24.2 With respect to moving objects, the following shall be considered as a minimum:

(a) objects hoisted and slewed by cranes that may come into contact with the OPTS;

(b) fixed objects that may come into contact with the moving OPTS.

8.24.3 Risks due to dropped and moving objects shall be mitigated in the following order of measures:

(a) By means of design: e.g. structural protection, position of the OPTS on board.

(b) By means of individual risk assessment: e.g. instructions for use shall require that the hazards due to dropped and moving objects are considered prior use.

8.24.4 Reference is made to ANSI/ISEA 121 *American National Standard for Dropped Object Prevention Solutions* for general guidance concerning dropped objects.

8.25 Fire safety

8.25.1 The main structural components of the OPTS are to be made of non-combustible material (i.e. steel). The use of other materials will be specially considered.

8.25.2 The active and passive fire protection arrangements and design are to be in compliance with the requirements of the mothership, e.g. Chapters 8.3 and 9 of IMO *Code for the Construction and Equipment of Mobile Offshore Drilling Units (2009 MODU Code)* and Chapter II-2 of IMO *International Convention for the Safety of Life at Sea (SOLAS), 1974*, etc. as applicable to the mothership.

8.25.3 Further to the mothership's stipulated requirements for active and passive fire protection arrangements, reference should also be made to any potential requirements of the OPTS interfaced with offshore hydrocarbon production and/or drilling installations, e.g. ISO 13702 *Petroleum and natural gas industries – Control and mitigation of fires and explosions on offshore production installations*, ISO 19353 *Safety of machinery – Fire prevention and fire protection*, etc. However, the intended position of the mothership and the planned location of the OPTS interface to the offshore installation is to be in a location outside the range of any credible accidental loads, e.g. explosion blast loads, fire, dropped objects, etc. This is considered to require particular attention for OPTS used with offshore hydrocarbon production and/or drilling installations.

8.25.4 For the aspects of fire protection of the control station the requirements of EN 13557 *Cranes – Controls and control stations* are to be satisfied.

8.25.5 Hydraulic oil tanks and filters are not to be situated immediately above boilers or other highly heated surfaces.

8.25.6 Hydraulic oil pipes, pumps, filters and other hydraulic components are not to be installed above or near high temperature equipment or other sources of ignition or onto rotating machinery parts. Where necessary, shielding is to be provided and the arrangements are to allow easy access for routine maintenance. Hydraulic oil pipes should also be installed and screened,

or otherwise suitably protected, to avoid oil spray or oil leakages onto hot surfaces, into machinery air intakes, or onto other sources of ignition such as electrical equipment. Pipe joints are to be kept to a minimum and where provided are to be of a type acceptable to LR. Pipes are to be led in well lit and readily visible positions.

8.25.7 Firewater hydrant cover over the OPTS gangway/access ways may be assessed and dispensed with, if the determined fire risks over these locations are considered to be low.

8.26 Hazardous areas

8.26.1 If the OPTS is operating in hazardous areas where explosive atmospheres may be present the requirements of this Section shall be satisfied.

8.26.2 The identification of hazardous situations shall be carried out as per the requirements of a recognised standard (IEC 60079-10-1 *Explosive atmospheres - Part 10-1: Classification of areas - Explosive gas atmospsheres*, EN 1127-1 *Explosive atmospheres - Explosion prevention and protection - Part 1: Basic concepts and methodoloy*, etc.).

8.26.3 Electrical equipment shall be in compliance with the requirements as detailed in IEC 60079 *Explosive atmospheress* series of standards and IEC 60079-14 *Explosive atmospheres - Part 14: Electrical installations design, selection and erection* in particular.

8.26.4 Non-electrical equipment shall be in compliance with the requirements as detailed in ISO 80079-36 *Explosove atmospheres - Part 36: Non-electrical equipment for explosive atmospheress - Basic method and requirement*.

8.26.5 The use of the OPTS with an offshore installation and any potential hazardous regions associated with an offshore installation needs to be fully considered. For OPTS used with offshore hydrocarbon production and/or drilling installations, particular attention needs to be paid to the potential large hazardous zones associated with such installations. The hazardous zones associated with such hydrocarbon production and/or drilling installations should be in accordance with a recognised Standard, e.g:

(a) EI (formerly IP) Part 15
(b) API RP 505 *Recommended Practice for Classification of Lcoations for Electrical Installations ate Petroleum Facilities, Classified as Class I, Zone 0, Zone 1 and Zone 2*,
(c) IEC 60092-502 *Electrical installations in ships - Part 502: Tankers - Special features*,
(d) IEC 61892-7 *Mobile and fixed offshore units - Electrical installations - Part 7: Hazardous areas*,
(e) IEC 60079-10-1 *Explosive atmospheres - Part 10-1:Classification of areas - Explosive gas atmospheres*,
(f) IMO Code for the Construction and Equipment of Mobile Offshoren Drilling Units (2009 MODU Code)

or established through distribution modelling.

8.26.6 In the case of an OPTS intended to form part of an offshore installation's evacuation arrangement, as detailed in *Ch 1, 8.19 Evacuation arrangements*, where the design intent of the OPTS and associated mothership is that they would remain in place during an installation incident, as part of a planned offshore installation evacuation route/system, then the hazardous regions associated with the interfaced offshore installation needs to be fully considered. The intended position of the mothership and the planned location of the OPTS interface with the offshore installation is to be in a location outside the range of any credible accidental loads, e.g. explosion blast loads, fire, dropped objects, etc. This is considered to require particular attention for OPTS used with offshore hydrocarbon production and/or drilling installations. For such OPTS, evacuation route arrangements for hydrocarbon production and/or drilling installations, any electrical equipment for the OPTS which has to remain operational during a Major Accident Event (e.g. rupture of an offshore installation process vessel or pipe), whether or not installed in a hazardous zone or location, is to be suitable for use in an explosive gas atmosphere. Such equipment is to be of a type permitted within Zone 1 locations, unless it is demonstrated that the equipment is appropriately protected against potentially coming into contact with a flammable atmosphere by being located in an enclosed safe area with appropriate mitigating measures. Mitigation methods acceptable to LR for enclosed safe areas may include, but are not limited to:

(a) equipment installed within enclosure with suitably sealed barriers and doors, with an adequate level of smoke integrity (i.e. 'A' or 'H' fire rated divisions, as per IMO *International Code for the Application of Fire Test Procedures (2010 FTP Code)* or IMO *Code for the Construction and Equipment of Mobile Offshore Drilling Units (2009 MODU Code)*) and gas tightness;
(b) rated gas dampers (gas tight to ISO 15138 *Petroleum and natural gas industries - Offshore production installations - Heating, ventilation and air-conditioning* stated requirements);
(c) suitable gas detection located at associated air intake ducts, with associated trip/closure logic; and
(d) enclosure positive pressurisation.

Other arrangements may also be submitted for consideration by LR. For further guidance regarding such arrangements, *see Pt 7, Ch 1 Safety and Communication Systems* and *Pt 7, Ch 2 Hazardous Areas and Ventilation* of the *Rules and Regulations for the Classification of Offshore Units, July 2022*.

8.27 Winterisation

8.27.1 Systems which are specially designed to operate in arctic conditions shall comply with the requirements of this sub-Section. The requirements of this sub-Section are related to winterisation level **Winterisation C(t)**, which is associated with an operational scenario of short duration transits in low temperatures, e.g. ships loading/discharging in low temperatures then sailing to discharging/loading in warmer regions. More severe operational scenarios will require special consideration beyond the requirements of this sub-Section.

8.27.2 Irrespective of winterisation, for general worldwide service OPTS are to be designed to a minimum design temperature of –10°C or lower. Reference is made to *Ch 4, 2.25 Materials 2.25.3* of the *Code for Lifting Appliances in a Marine Environment, July 2022.*

8.27.3 If the OPTS is intended to be used in environmental conditions where significant amounts of snow and ice are present the requirements of this sub-Section are to be complied with. *See also* LR's *Rules for the Winterisation of Ships, July 2022*.

8.27.4 For all areas other than gangway and machinery the effects of ice and snow are to be considered and are to be mitigated by design or instructions for removal.

8.27.5 The OPTS is to be freed from snow and ice as far as possible unless the adverse effects of snow and ice are considered in the design of the OPTS. Examples for special design for winterisation of the gangway could be a fully enclosed gangway where the accumulation of snow and/or ice has been considered in the design.

8.27.6 The accumulation of ice and snow on the machinery components shall be considered and if the removal of ice and/or snow is not possible any adverse effect shall be eliminated by design (e.g. covering of machinery parts).

8.27.7 *See also Ch 1, 1.4 Definitions 1.4.7*, *Ch 1, 5.1 General 5.1.2* and *Ch 1, 5.11 Ice removal and prevention measures* (as applicable) of LR's *Rules for the Winterisation of Ships, July 2022* concerning of ice removal and prevention measures.

8.27.8 Means are to be provided for habitable working conditions in Control cabins, where fitted, by providing internal space heating arrangements. Cabin windows are to be provided with heating arrangements to protect from the build-up of ice, *see Ch 1, 5.8 Winterisation of spaces/compartments 5.8.1* and *Ch 1, 5.8 Winterisation of spaces/compartments 5.8.3* of the *Rules for the Winterisation of Ships, July 2022*. Ice removal measures are to be provided to protect against icing. Window wiper operating devices are to be arranged inside the cabin or to be provided with heating arrangements.

8.27.9 Exposed control panels are to be provided with suitable steel covers to protect against icing.

8.27.10 Electrical installations are to comply with *Ch 1, 5.6 Winterisation of electrical installations* of the *Rules for the Winterisation of Ships, July 2022*.

8.27.11 For hydraulically operated equipment and systems, steam ice removal measures (or other means) are to be provided for protection against icing.

8.27.12 Measures are to be provided to protect against freezing of fluids, such as lubricants and hydraulic oil. The fluids are to be suitable for low temperature operation, and heating arrangements are to be provided where appropriate.

8.27.13 Hydraulic control systems are to comply with *Ch 1, 5.4 Winterisation of auxiliary machinery systems and deck working areas* of LR's *Rules for the Winterisation of Ships, July 2022*.

8.27.14 Suitable provisions for cold start arrangements for exposed deck cranes are to be provided. Suitable lubrication oils and greases, circulation facilities for hydraulic oils and a flushing system for the hydraulic oil are to be provided.

8.27.15 Material grades are to be in accordance with the requirements of *Ch 1, 12 Materials and fabrication* and suitable for operation at the external design air temperature.

Section 9
Electrotechnical systems

9.1 Goal

9.1.1 Electrotechnical systems for OPTS are to be designed according to the safety concept as required by *Ch 1, 1.12 Information to be submitted 1.12.24* and constructed in accordance with the requirements of this Section in order to minimise danger to personnel in all foreseeable operating conditions and foreseeable failure scenarios.

9.2 General

9.2.1 In addition to requirements stipulated in this Section, the relevant requirements for control, alarm and safety systems as stated in *Pt 6, Ch 1 Control Engineering Systems* and *Pt 6, Ch 2 Electrical Engineering* of the *Rules and Regulations for the Classification of Ships, July 2022* and *Ch 10 Electrotechnical Systems* of the *Code for Lifting Appliances in a Marine Environment, July 2022* are to be complied with as applicable.

9.2.2 The requirements as per *Ch 1, 9.4 Active systems (ST-A or ST-H) 9.4.2*, *Ch 1, 9.5 Passive systems (ST-P) 9.5.2* and *Ch 1, 9.7 Disconnection systems* (as applicable) are to be verified by means of a failure mode, effects (and criticality) analysis (*see also Ch 1, 10 Risk assessment*).

9.2.3 The electrical installation of the OPTS is to be designed in accordance with *Ch 10 Electrotechnical Systems* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

9.2.4 The design and position of the Operator station shall enable the Operator to oversee the area affected by the OPTS, the OPTS itself and the target area of the gangway. Additional means such as CCTV systems might be necessary to supplement the Operator's view (*see Ch 1, 9.6 Electrical and control engineering arrangements 9.6.5*).

9.2.5 Wireless remote-control arrangements will be specially considered. *See Pt 6, Ch 1 Control Engineering Systems* of the *Rules and Regulations for the Classification of Ships, July 2022*. Reference should also be made to EN 62745 *Safety of machinery - Requirements for cableless control systems of machinery*.

9.2.6 Sufficient fixed lighting is to be provided on the OPTS in all operational phases to enable personnel to safely transfer and to enable the Operator to maintain view on the system for OPTS operated at low daylight conditions or at night. The minimum levels of lighting are to be 1000 Lux for the pre-operation phase, post operational phases and emergency and failure modes. During normal operation the minimum level is to be 220 Lux. Battery powered emergency lighting with a minimum lighting level of 50 Lux is to be provided for 30 minutes in case of a main power supply failure. Sufficient fixed lighting is to be provided for all required maintenance activities. Lighting on OPTS is to be directed away from, and shaded to prevent direct illumination of, the bridge windows and lookout points.

9.2.7 It shall only be possible to override the safety systems if this is required to safely terminate the operation and evacuate the personnel from the OPTS.

9.2.8 Sensors, limit switches and its associated systems for control, alarm, monitoring, safety and indication shall be fail-safe. *See Pt 6, Ch 1, 2.3 Alarm systems, general requirements 2.3.13*, *Pt 6, Ch 1, 2.4 Safety systems, general requirements 2.4.5*, *Pt 6, Ch 1, 2.5 Control systems, general requirements 2.5.3* and *Pt 6, Ch 1, 2.10 Programmable electronic systems - General requirements 2.10.7* of the *Rules and Regulations for the Classification of Ships, July 2022*.

9.3 Alarms and warnings

9.3.1 The OPTS shall initiate an alarm in at least, but not limited to, the following cases:

(a) the geometrical limits of the OPTS are reaching 90 per cent of the maximum limits;
(b) the actual personnel transfer gangway inclination angle is reaching 90 per cent of its maximum limit;
(c) DP system failure or loss of required DP station keeping performance, where it is sufficient that the positioning failure of the vessel is judged, and the alarm is enabled by the DP Operator to be shown also at the OPTS control station;
(d) detection of an overload by the overload detection system (unless design margins are as such that overload is prevented under all circumstances);
(e) loss of or insufficient power source;
(f) loss of required pushing force under consideration of a defined tolerance;
(g) failure of control systems;
(h) failure of safety systems (e.g. emergency disconnection);

(i) failure of stored energy or secondary power systems; and

(j) when the measured wind speed exceeds a predetermined limit for a given time.

9.3.2 Alarms and warnings shall follow the philosophy of the *Code on Alerts and Indicators (2009)* and consist of the stages as shown in *Table 1.9.1 Definition of alert priority, signalling and resulting actions*.

9.4 Active systems (ST-A or ST-H)

9.4.1 For the definition of active (ST-A) and hybrid (SL-H) systems *see Ch 1, 2.2 System types 2.2.1* and *Ch 1, 2.2 System types 2.2.3* respectively.

9.4.2 Any failure in the power supply, control system and actuators shall not result in uncontrolled, unintended movements of the system or blocking of the emergency stop of the system. The OPTS shall be under positive control at all times during operations (including pre- and post-operational phases). A fail-safe provision is to be designed to automatically stop or safely control equipment when hydraulic or electrical failure occurs. The OPTS shall be provided with interlocks, safety devices and protective devices so that it will be fail-safe in case of an emergency. Depending on the safety concept (*see Ch 1, 1.12 Information to be submitted 1.12.24*) a redundant control system and its associated redundant systems might be required to be implemented. In the case of a loss of redundancy the operation of the OPTS shall be terminated. Alternatively, a single control system failing to a passive mode or last position can be considered acceptable (*see also Ch 1, 9.5 Passive systems (ST-P) 9.5.2* and *Ch 1, 9.7 Disconnection systems* for the principle safety goals).

9.4.3 The alarm system is to be designed, as far as practicable, to function independently of control and safety systems such that a failure or malfunction in these systems will not prevent the alarm system from operating (*see Pt 6, Ch 1, 2.3 Alarm systems, general requirements 2.3.15* of the *Rules and Regulations for the Classification of Ships, July 2022*). If no separate systems are used for alarms and controls a redundant system is required. Any failure in the control system shall not cause the loss of the related alarm functions.

9.4.4 If controls are necessary to discontinue the operation of the OPTS, then these controls shall be independent from the control system intended for the operational use. Its operation shall not be blocked by any failure of the control system for the operational use. Depending on the safety concept, a redundant control system can be considered compliant with this requirement.

9.4.5 If a power source is necessary to enable the discontinuation process of the OPTS operation, an independent (from the normal operational) power source or stored means of energy shall be provided to enable the discontinuation of the operation safely and in a controlled way.

9.4.6 If systems are being operated by single Operators, a dead man switch shall be provided, with a time resetting interval suitable to ensure a safe operation of the system.

9.4.7 Automated actions by the control systems affecting the transfer of the personnel shall initiate an audible and visual staged level alarm clearly recognisable by the Operator and the transferring personnel. The automated action shall have a suitable delay after the alarm to enable the transferring personnel and the Operator to take appropriate actions (*see Ch 1, 9.4 Active systems (ST-A or ST-H) 9.4.9*).

Table 1.9.1 Definition of alert priority, signalling and resulting actions

Alert priority/ type	Alert conditions	Operator signalling	Operator action required	Personnel signalling	Personnel action required	Examples for alerts
3/Alarm	Condition requiring immediate attention and action, to maintain the safe operation or be able to safely terminate the operation of the OPTS.	Red	• Yes, immediately • Operator actions as per instruction for use	Red	Leave gangway immediately	• Operational limits are being exceeded • Full or partly loss of functionality • Full or partly loss of redundancy • Loss of or insufficient main power supply
2/Warning	Condition requiring no immediate attention or action. Warnings are presented for precautionary reasons to bring awareness of changed conditions which are not immediately hazardous, but may become so if no action is taken.	Orange	• Yes • Timeframe for Operator actions as per instruction for use • Operator to decide whether to abandon operations and signalling to the personnel	Red or Green	Leave gangway if alarm signalled by Operator	• Operational limits are being approached (90% of max limits) • Relative movement between mothership and target unit approaches limits • Intended disconnection between OPTS and target unit • Overload detected

1/Caution	Awareness of a condition which does not warrant an alarm or warning condition, but still requires attention out of the ordinary consideration of the situation or of given information.	Yellow	• Yes • Timeframe for Operator actions as per instruction for use	Green	Transfer may commence	Low oil level in hydraulic system
0/Normal operation	N/A	Green	• Yes • Normal operation • Operator to set signalling for personnel to green if considered safe	Green	Transfer may commence	N/A

9.4.8 At a pre-determined time after priority 3 alerts, the OPTS shall automatically progress to a pre-defined safe state. The pre-determined time shall enable the Operator to prepare for the safe stop of the system and the transferring personnel to move to a safe area.

9.4.9 Suitable means of communication should be available between the Operator position and the mothership bridge or control station as well as the target unit.

9.4.10 Failure of any power supply for the OPTS, failure of the control system, or the OPTS approaching or exceeding its operational limitations shall result in an audible and visible alarm to the Operator. In such cases the system shall allow for the return to the stowage or otherwise safe position either manually or automatically.

9.4.11 An indication of at least the following parameters, as far as relevant for the OPTS, should be monitored and displayed over a pre-determined time (commonly called trending):

(a) OPTS motions (e.g. telescoping, slewing and luffing, compensating for heave, roll and pitch) or OPTS forces (e.g. push force against target structure) or mothership motions to be compensated;

(b) target unit motions (if applicable); and

(c) wind speed.

These indications should be displayed relative to the operational limitations of the OPTS and shall enable the Operator to determine whether the operational limits are approached. A warning shall be generated in case the operational limitations are approached more than once over a pre-determined time period. The operational limitations are considered being approached, if 90 per cent of the limit value is reached or exceeded.

9.4.12 Inactive redundant components necessary to comply with *Ch 1, 9.4 Active systems (ST-A or ST-H) 9.4.2* shall be checked prior to operation of the OPTS and an automatic check prior to start-up by the control system may be part of this check. The necessary start-up checks need to be prescribed in the instructions for use.

9.4.13 An emergency stop system for safe discontinuation of the operation of the OPTS and to enable safe evacuation of personnel from the OPTS shall be provided. The emergency stop system shall be independent from the control system and shall also initiate an automatic disconnection of the gangway from the target unit. The emergency stop system shall not endanger or pose a hazard to personnel or Operator due to abrupt movements or unfavourable movements and shall bring the system to a pre-defined safe state (before the emergency stop independently stops the OPTS motions).

9.4.14 The emergency stop shall only be located at Operator control stations.

9.4.15 An initiated emergency stop shall result in an audible and visual alarm clearly recognisable for the Operator(s) and the transferring personnel.

9.4.16 Failure in the emergency stop system shall not result in an unintended stop of the OPTS. A failure in the emergency stop system shall initiate an alarm at the Operator station.

9.4.17 The accuracy of landing for gangway tip relative to target structure on the target unit for cantilevered gangways is ±100 mm. Higher values will be specially considered depending on the design risk assessment.

9.5 Passive systems (ST-P)

9.5.1 For the definition of passive systems *see Ch 1, 2.2 System types 2.2.2*.

9.5.2 A failure in the control system only used for connection and disconnection prior to and after operations of the passive system shall not block free movement of the passive system during operation.

9.5.3 Means of disconnection shall be provided in cases of normal operation and in emergency cases.

9.5.4 An emergency stop independent of the control system for connection and disconnection shall be provided.

9.5.5 The system approaching or exceeding its operational limits should result in an audible and visible alarm to the Operator.

9.5.6 Systems with unrestricted access shall provide a local alarm for the personnel using the system when approaching the operational limits and for remote disconnection, if provided.

9.6 Electrical and control engineering arrangements

9.6.1 Every OPTS is to have a dedicated Operator station and/or operation panel.

9.6.2 Apart from fully passive systems the OPTS shall have controlling devices fitted.

9.6.3 Indicating devices are required to e.g. display the system status, etc. Reference is made to *Pt 6, Ch 1, 2.5 Control systems, general requirements 2.5.5* of the *Rules and Regulations for the Classification of Ships, July 2022*.

9.6.4 Actuators, winches, telescopic gangways and similar moving components shall come to a controlled stop before the mechanical end stop is reached.

9.6.5 Observation devices may be, e.g. cameras which provide visible access to locations where the Operator may not have direct visual contact. Possible camera coverage may include:

(a) along the gangway; and/or
(b) at the gangway tip.

9.6.6 Sensing devices shall be provided to enable monitoring of the status of certain parts of the OPTS such as load cells, etc.

9.6.7 In case of limited access systems, access control systems shall provide means to restrict the access to the gangway, e.g. ‘traffic lights’ in combination with Operator instructions or automatic crossing gate systems. Acoustic signalling systems (e.g. talkback or sounders) are also considered part of an access control system.

9.6.8 The sampling rate for the sensing devices shall be determined as a result of the risk assessment and shall take into account the motion speeds of the OPTS.

9.6.9 Any restart of the control system for any reason (e.g. power failure, control system failure, etc.) shall not lead to unsafe conditions for:

(a) transferring personnel on the OPTS;
(b) the Operator of the OPTS; or
(c) any personnel or crew in the vicinity of the OPTS.

9.7 Disconnection systems

9.7.1 The principle overview over the connection system types can be seen in *Figure 1.9.1 Connection systems*.

9.7.2 The OPTS gangway tip shall not inadvertently disconnect from the target structure, e.g. due to single point system failure.

9.7.3 If the OPTS gangway is approaching its limits an alarm should be raised (*see Ch 1, 9.4 Active systems (ST-A or ST-H) 9.4.11*).

9.7.4 The connection system of a gangway for an OPTS shall have redundancy in power, controls and actuators in such a way that inadvertent disconnection is prevented. As an alternative, an OPTS gangway with a fixed connection could remain

connected in the case of a power loss or system failure, however, it should be able to mechanically release in case excessive force is exerted on the OPTS or gangway.

9.7.5 A disconnection of an OPTS gangway shall not result in an inadvertent lowering (luffing) of the OPTS gangway.

9.7.6 The system is to be designed to enable safe disconnection and also emergency disconnection (lift-off) at all times (e.g. mothership blackout).

9.7.7 The OPTS needs to be equipped with an emergency disconnection system. The system needs to enable safe disconnection, retraction of any telescopic arrangements and landing of the gangway in a safe position. In case of an emergency which requires the emergency disconnection (lift-off) to be initiated, a visual and acoustic alarm is to be activated a considerable time before the actual lift-off, allowing personnel to safely evacuate the gangway.

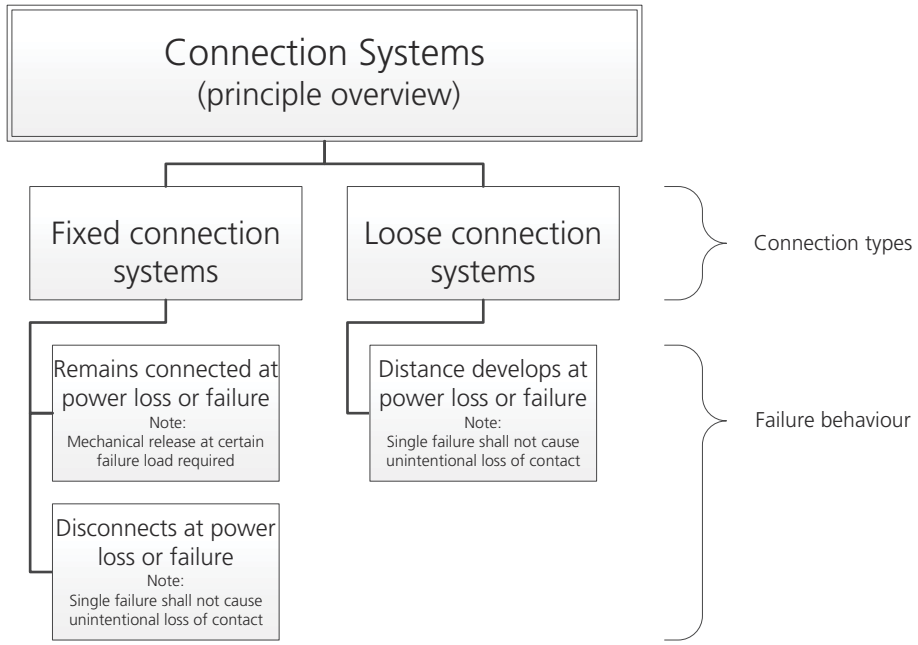

Figure 1.9.1 Connection systems

9.8 Security of automation and control systems

9.8.1 Potential threats related to the security of the OPTS should be identified, addressed and mitigated. *See Ch 1, 10 Risk assessment.*

9.8.2 The following aspects shall at a minimum be addressed in particular:

(a) roles and responsibilities of key personnel and management involved in the operations and maintenance of the OPTS;

(b) policies, procedures, assets, data and capabilities, which if disrupted, could pose risks to the OPTS operations and safety; and

(c) technical measures to protect against a cyber incident to ensure safety and continuity of operations.

9.8.3 Refer to the following publications for guidance:

(a) LR's ShipRight Procedure for the *Assessment of Cyber Security for Ships and Ships Systems*;

(b) IEC 62443 *Security for industrial automation and control systems* series of standards, on how to secure information and communication technology aspects of industrial processes;

(c) ISO/IEC 27001 *Information technology – Security techniques – Information management Systems – Requirements*, on how to keep information assets secure; and

(d) Baseline Security Recommendations for Internet of Things (IoT) in the context of Critical Information Infrastructures, ENISA, NOVEMBER 2017, on how to ensure security in IoT products and services.

Section 10
Risk assessment

10.1 General

10.1.1 Risk assessment provides a systematic method for the assessment of the risks posed to the operational and non-operational safety and integrity of the OPTS, its relevant components and interfaces and the interaction with the mothership.

10.1.2 It is required to carry out a risk assessment for the OPTS under due consideration of the conditions of the system (e.g. mothership, environmental) the OPTS will be installed in and the interfaces between the OPTS and the mothership. The risk assessment shall include the interaction of the OPTS components with complete system and its environment. The risk assessment shall be carried out taking into account the methodology as given in this Section.

10.1.3 It is anticipated that the risk assessment shall demonstrate the design conforms to relevant good engineering practice and sound safety principles whilst at the same time referring to but not duplicating previous relevant assessments.

10.2 Risk assessment procedure

10.2.1 The designer/manufacturer shall prepare a Safety Statement in compliance with LR's ShipRight Procedure*Risk Based Certification (RBC)* process which, as a minimum, shall describe:

(a) the boundary of the system intended to be assessed;
(b) the risk management process intended to be followed;
(c) the risk assessment tools intended to be used; and
(d) the acceptance criteria that will be used to determine if a risk is tolerable.

The RBD process requires the designer/manufacturer to carry out a suitable and sufficient risk assessment based on own information and experience and information received from the Owner and/or Operator.

10.2.2 It shall be ensured that the boundaries of the risk assessment are set wide enough to suitably and sufficiently assess the system which is defined as the OPTS and its components embedded in its environmental situation (e.g. mothership, integration of the OPTS into the mothership system, environmental conditions such as wind, $H_{1/3}$, heel/trim, mothership accelerations, etc.). The system is required to be assessed in its entirety, and the boundaries are to be shifted until there are no parts or components having any influence on the OPTS and vice versa.

10.2.3 It is the responsibility of the designer/manufacturer to ensure the intended process and acceptance criteria meet the requirements of the National Authority, the Owner/Operator and LR as given in the RBD. It is further required that the intended process and acceptance criteria are acceptable to the National Authority who may have requirements in addition to the methodology given in this Section and/or the RBD process.

10.2.4 Performance requirements are to be developed for the OPTS and its components and critical elements in order that they will manage the identified hazards.

10.2.5 The risk assessment shall clearly set out the boundaries of the system to be assessed. As a minimum, it should consider the safety of the system during normal operation, during emergency conditions and while the system is out-of-service. As a minimum, the assessment is required to:

(a) demonstrate the system meets the performance requirements;
(b) demonstrate the OPTS meets the performance requirements;
(c) demonstrate the components of the OPTS meet the performance requirements;
(d) take into account the interfaces between the OPTS and the mothership and the target unit;
(e) identify the potential hazards to the safety and integrity of the system and OPTS and specifically quantify and rank these risks in terms of their consequence and frequency;
(f) identify those risks that are unacceptable in relation to the defined performance requirements;
(g) identify what prevention and/or mitigation actions are to be taken in order to reduce the risks that are unacceptable to a level tolerable to LR and the National Authority;
(h) identify parts and/or components of the OPTS and the system that are critical in relation to the management of the identified risks and hazards;
(i) clearly identify the hazards that may threaten the safety or integrity of the system and/or the OPTS, or otherwise endanger the Operators, personnel to be transferred, any crew members and other persons;

(j) identify any additional testing or trials required to provide evidence the defined performance requirements can be met; and
(k) describe the method by which any action points raised will be closed out and name the responsible persons.

10.2.6 Suitable protective measures and safety features shall be introduced as a consequence of the risk assessment.

10.2.7 The instructions for use of the OPTS shall be compiled based upon the findings of the risk assessment.

10.2.8 The designer/manufacturer is responsible for communicating the output of the assessment to the Owner and/or Operator.

10.2.9 The designer/manufacturer is responsible for implementing any mitigation measures relevant to the design of the OPTS. The Owner and/or Operator is responsible for implementing any mitigation measures relevant to the operation of the OPTS. One of the outcomes of the risk assessment shall be to establish who is responsible for which mitigation measures and the definition of the interfaces between the designer/manufacturer and the Owner and/or Operator.

10.2.10 The risk assessment should be carried out in accordance with relevant and recognised National and International Standards. In particular, the following standards shall be taken into consideration as a minimum:

(a) ISO 31000 *Risk management*;
(b) EN 31010 *Risk management – Risk assessment techniques*;
(c) ISO Guide 73 *Risk management – Vocabulary*; and
(d) ISO 12100 *Safety of machinery – General principles for design – Risk assessment and risk reduction*.

10.2.11 Whilst the designer/manufacturer may use specialised support to produce the risk assessment, they remain accountable for the production of the risk assessment and demonstrating that deviating from the prescribed requirements does not lead to an increase in risk.

10.3 Hazards

10.3.1 In general, the generic list of hazards as given in ISO 12100 *Safety of machinery – General principles for design – Risk assessment and risk reduction*, Annex B shall be applied for the risk assessment.

10.3.2 Project, design and environmental specific hazards need to be taken into account in addition to the generic hazards of ISO 12100 *Safety of machinery – General principles for design – Risk assessment and risk reduction*.

10.3.3 Hazards to be considered are to include, but shall not be limited to, the items as listed in *Table 1.10.1 Hazards directly affecting the OPTS or the mothership* and *Table 1.10.2 Hazards directly applicable to personnel* (as applicable):

Table 1.10.1 Hazards directly affecting the OPTS or the mothership

Hazard cause (examples)	Hazard consequence (examples)
• structural failure • control system failure • incorrect use • inability to safely put the OPTS into stowage mode and apply the stowage arrangement	Degradation of mothership safety resulting in injury or fatality
• failure of main support structure, wire ropes, winches, hydraulic cylinders, hydraulic/electrical motors, brakes • wrong erection of the system when installed on the mothership • exceeding of design parameters of the OPTS due to environmental hazards such as waves, wind, snow, ice, heat, cold • loss of manoeuvrability or false manoeuvring of the mothership supporting the OPTS or the target unit (e.g. inadequate operation of the DP-System) • limitations of maintainability	Loss of structural integrity of the OPTS and/or its components and component parts resulting in injury or fatality

• failure of control system • failure of access control system • failure of brakes • failure of pilot operated non-return valve • failure of load holding valves	Loss of systems essential to maintain the safety and/or integrity of the OPTS and/or its components resulting in injury or fatality
• failure of energy source (hydraulic, electric) • failure of electrical systems • failure of hydraulic and/or pneumatic systems • failure of sensors or limit switches • failure of electrical or hydraulic actuators • failure of control system • restart of the control system for any reason • unexpected start-up • lightning • high wind speeds • accumulation of snow and ice • inappropriate restart of the system after emergency stop, power supply failure or similar events • inadequate location and/or arrangement of systems and equipment • reasonably foreseeable misbehaviour of passengers • non-considered health condition of passengers • aspects of evacuation of passengers from OPTS (personnel containment and gangway) • reasonably foreseeable Operator error	Loss of control over the OPTS and/or its components and component parts resulting in injury or fatality Loss of contact between OPTS and target unit.
Combination of various hazards causing new hazards	

Table 1.10.2 Hazards directly applicable to personnel

Hazard category (examples)	Hazard consequence (examples)
	Injury or fatality due to:
Mechanical systems and components	• dropped objects • crushing • cutting • impact due to release of stored mechanical energy, e.g. stored in wire ropes and flexible parts under tension or compression • impact of gas, fluid, parts due to release of high-pressure fluids or gases and general spillage of such substances
Electrical systems	• electrocution • burns
Thermal effects	• burns • dehydration • frostbite • discomfort

Noise	• damage or loss of hearing • tinnitus • loss of balance • loss of communication • stress
Vibration	• discomfort • neurological disorder
Radiation	• burn • insomnia • headache
Harmful materials and substances	• fire • explosion • corrosion • poisoning • suffocation
Unsuitable ergonomic design	• slipping • tripping • falling • stress
Environment	• slipping • tripping • falling
Inadequate means of escape and escape routes from the OPTS	
Combination of various hazards causing new hazards	

10.3.4 National Authority requirements may specify additional hazards to be considered. It is the responsibility of the Owner/Operator to comply with any requirements of the National Authorities.

■ *Section 11*
Quality assurance system

11.1 General

11.1.1 The appliance designer/manufacturer shall have a documented quality assurance system with a 'continuous improvement process' in place. The quality assurance system shall be in compliance with a recognised National or International Standard, e.g. ISO 9001 *Quality management systems – Requirements*.

11.2 Feedback

11.2.1 The continuous improvement process as part of the quality assurance system shall take account of the findings from operational and non-operational experience and feedback with a view to:

(a) further improvements in the design, operating procedures and instructions for use;
(b) further improvements to the maintenance of existing appliances in service;
(c) an adjustment of inspection intervals; and
(d) an adjustment of scheduled maintenance and replacements of parts.

11.2.2 The operational and non-operational experience and feedback may be provided through the designer's/manufacturer's own experiences and/or provided by the appliance's Owner and/or Operator, maintainers, inspectors/Surveyors and competent persons.

Section 12
Materials and fabrication

12.1 General

12.1.1 In general, the requirements of *Ch 1, 1.6 Materials and fabrication*, *Ch 4, 2.25 Materials* and *Ch 11 Materials and Fabrication* of the *Code for Lifting Appliances in a Marine Environment, July 2022* are applicable to the materials and fabrication of OPTS and their components.

12.1.2 Manufacturers of OPTS and components shall have a suitable quality management (QM) system as per the requirements of ISO 9001 *Quality management systems – Requirements* in place. The manufacturer's QM system shall be certified by an accredited certification body.

12.2 Material selection

12.2.1 Classed OPTS shall be constructed of material which complies with LR's *Rules for the Manufacture, Testing and Certification of Materials, July 2022*. Reference is made to *Ch 1, 1.6 Materials and fabrication 1.6.1(a)* and *Ch 1, 1.6 Materials and fabrication 1.6.1.(b)* of the *Code for Lifting Appliances in a Marine Environment, July 2022* only.

12.2.2 Certified OPTS shall, as a minimum, be constructed of material which complies with a recognised National or International Standard provided the requirements are equivalent to LR's *Rules for the Manufacture, Testing and Certification of Materials, July 2022*, but where the approval and survey requirements will not comply with the requirements of *Ch 1 General Requirements* and Section 1 of subsequent Chapters, of the *Rules for the Manufacture, Testing and Certification of Materials, July 2022*, materials may be subject to additional testing under LR survey prior to acceptance for any project at the discretion of the Surveyor. Reference is made to *Ch 1, 1.6 Materials and fabrication 1.6.1(a)*, *Ch 1, 1.6 Materials and fabrication 1.6.1.(b)* and *Ch 1, 1.6 Materials and fabrication 1.6.1.(c)* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

12.2.3 Material specifications that have no equivalent to LR's *Rules for the Manufacture, Testing and Certification of Materials, July 2022* will be subject to special consideration by LR. Reference is made to *Ch 1, 1.6 Materials and fabrication 1.6.1.(d)* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

12.2.4 The materials shall be delivered in the hot finished condition and shall be of the fine grain steel type.

12.2.5 Carbon steel bolts are to be specified in accordance with ISO 898 *Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs with specified property classes – Coarse thread and fine pitch thread*. Bolts are to be selected within the range 8.8 to 10.9 (inclusive). Bolt materials in other materials such as stainless steels are to be specified in accordance with a recognised National or International Standard. The required level of certification for bolts is given in *Ch 1, 12.8 Documentation*.

12.2.6 LR shall be contacted in early design stages if material is proposed which is not defined in the *Rules for the Manufacture, Testing and Certification of Materials, July 2022*.

12.2.7 The application of aluminium or composite materials will be specially considered.

12.2.8 A suitable corrosion protection system is to be selected and applied by the designer/manufacturer depending on the expected corrosivity environment. If a protective paint system has been selected it shall comply with the requirements of the applicable parts of ISO 12944 *Paints and varnishes – Corrosion protection of steel structures by protective paint systems*. If there is no corrosivity category agreed between the Owner/Operator and the designer/manufacturer the corrosivity category 'CX' as defined in ISO 12944 *Paints and varnishes – Corrosion protection of steel structures by protective paint systems* shall be selected. All items and areas are to be sufficiently protected against corrosion for the agreed protection duration of the system. If there is no protection duration agreed between the Owner/Operator and the designer/manufacturer the durability range 'H' (as a minimum) as defined in ISO 12944 *Paints and varnishes – Corrosion protection of steel structures by protective paint systems* shall be selected. If the system is to be operated beyond the agreed protection duration or the duration of the durability range of ISO 12944 *Paints and varnishes – Corrosion protection of steel structures by protective paint systems*, additional maintenance inspections are to be carried out and appropriate defect criteria are to be defined in the maintenance section of the instruction for use.

12.3 Brittle fracture

12.3.1 All materials are required to provide adequate resistance against brittle fracture, and in general to comply with the requirements of:

(a) *Ch 4, 2.25 Materials 2.25.2* of the *Code for Lifting Appliances in a Marine Environment, July 2022*;

(b) *Ch 4 Cranes and Submersible Lifting Appliances*, *Table 4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel* of the *Code for Lifting Appliances in a Marine Environment, July 2022*;

(c) *Ch 4 Cranes and Submersible Lifting Appliances*, *Table 4.2.18 Charpy V-notch impact test energy requirements for classed and certified lifting appliances* of the *Code for Lifting Appliances in a Marine Environment, July 2022*; and

(d) *Ch 4 Cranes and Submersible Lifting Appliances*, *Table 4.2.19 Charpy V-notch impact test temperature requirements for non-welded components (excluding slew bearings) subject to tensile loading. Excludes stainless steels* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

12.3.2 As an alternative to the requirements of *Ch 1, 12.3 Brittle fracture 12.3.1*, proposals to use engineering critical assessment approaches, to establish that fracture toughness requirements have been addressed, will be subject to special consideration. The designer shall contact LR in the early stages of the projects regarding acceptance of such proposals.

12.3.3 Proposals for resistance against brittle fracture for minimum design temperatures (MDT) below -40°C will be specially considered.

12.4 'Z' grade steel

12.4.1 The use of 'Z' grade steel is recommended where the structural steel is subjected to tension stresses in the through thickness direction (e.g. cruciform or t-shape joints).

12.4.2 Where Z grade steel is specified the requirements of *Ch 3, 8 Plates with specified through thickness properties* of the *Rules for the Manufacture, Testing and Certification of Materials, July 2022*, shall be met and, if necessary, supplementary guidance on selection of Z25 or Z35 may be obtained from a recognised National or International Standard acceptable to LR to ensure structural integrity of the proposed design.

12.5 Minimum thickness

12.5.1 The minimum thicknesses are to be in compliance with *Table 1.12.1 Minimum material thickness*.

Table 1.12.1 Minimum material thickness

Type of structural member	Minimum thickness
Critical structure	6 mm *see* Note
Primary structure	4 mm
Secondary structure	4 mm
Note Lower thicknesses will be specially considered if acceptable technical justification is provided and the proposed thickness is specifically addressed in the risk assessment, e.g. taking account of the robustness (structural member size related to thickness) of the structural design detail which is employing the lower thickness.	

12.5.2 The minimum bolt size for critical and primary structural components shall be M12. The application of smaller bolt sizes will be specially considered.

12.6 Fabrication

12.6.1 The fabrication and inspection of classed OPTS are to be in compliance with *Ch 11, 2.1 Fabrication of classed lifting appliances* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

12.6.2 The fabrication and inspection of certified OPTS are to be in compliance with *Ch 11, 2.2 Fabrication of certified lifting appliances* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

12.6.3 OPTS are required to be built under survey of an LR Surveyor in case certification or classification is requested.

12.6.4 Before fabrication commences an Inspection and Test Plan (ITP) shall be prepared by the designer/manufacturer. This ITP shall be further discussed and agreed between the designer/manufacturer of the OPTS (or its components) and the attending Lloyd's Register Surveyor. The ITP shall meet the requirements of this document.

12.6.5 Non-destructive examination is to be carried out by qualified Operators as per the minimum requirements given in *Ch 12, 3.2 Initial Survey of new installations 3.2.4* of the *Code for Lifting Appliances in a Marine Environment, July 2022* to the Surveyor's satisfaction. 100 per cent visual examination is required in all cases for all welds. Reference is made to *Ch 1, 13.3 Initial survey of new installations 13.3.2* for an OPTS specific definition of critical, primary and secondary welds.

12.6.6 Any classification and acceptance criteria of weld imperfections shall be in accordance with ISO 5817 *Welding – Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections*.

12.6.7 The quality level of critical, primary and secondary welds and weld connections between critical, primary and secondary components shall be in compliance with *Table 1.12.2 Weld quality levels*.

Table 1.12.2 Weld quality levels

Welds and weld connections between components	Quality level Note
Critical welds or welds connected to critical components	B
Primary welds or welds connected to primary components	C or higher
Secondary welds or welds connected to secondary components	D or higher
Note The quality levels are defined in ISO 5817 *Welding – Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections*.	

12.6.8 Concerning welds subject to fatigue, reference is made to Annex C of ISO 5817 *Welding – Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections*.

12.6.9 The designer/manufacturer should have a system of dimensional checks in place ensuring that the components and the system as a whole will be built in accordance with the approved plans.

12.6.10 The agreed corrosion protection system is to be applied in accordance with the agreed specification and manufacturer's recommendations.

12.7 Repairs

12.7.1 Repairs for classed OPTS shall be in compliance with LR's *Rules for the Manufacture, Testing and Certification of Materials, July 2022*.

12.7.2 Repairs for certified OPTS shall be in compliance with *Ch 11, 2.2 Fabrication of certified lifting appliances 2.2.2* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

12.7.3 The following two types of repair shall be distinguished. Repairs necessary due to:

(a) damages occurring during construction; and
(b) in-service or out-of-service damages of completed OPTS.

12.7.4 In cases of damages occurring during construction the root cause of damage may be evaluated in order to avoid reoccurrence. LR shall be contacted to carry out a survey of the damage.

12.7.5 In cases of in-service or out-of-service damages the root cause of damage shall be evaluated in order to avoid reoccurrence. Reference is made to *Ch 1, 13.7 Damage surveys* and *Ch 13, 2.3 Damage surveys* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

12.7.6 In order to maintain the validity of the LR certification or classification, LR is to be contacted in case of in-service or out-of-service damages to carry out a survey as per the requirements of *Ch 1, 13.7 Damage surveys* and *Ch 13, 2.3 Damage surveys* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

12.7.7 The details of the repair and the repair procedure shall be discussed and agreed with the attending Surveyor before commencing the repair.

12.7.8 The materials used in the repair shall be the same as the original specification. Any deviations from the originally approved materials shall be agreed with LR and as a minimum provide equivalence with those of the original approved design and shall comply with the requirements of these Rules.

12.8 Documentation

12.8.1 The designer/manufacturer of the OPTS shall have a system in place which ensures that all raw materials can be traced from purchasing to receipt at the manufacturer's works until being used in the OPTS construction.

12.8.2 The required documentation for the materials used in classed OPTS applications is provided in *Table 1.12.3 Material documentation for classed applications*. *See Ch 1, 1.6 Classification procedure*.

Table 1.12.3 Material documentation for classed applications

Type of structural member	Documentation
Critical structural component	'LR Certificate' or 'Manufacturer's Certificate validated by LR'
Primary structural component	'Manufacturer's Certificate' (equivalent to EN 10204, inspection certificate 3.1)
Secondary structural component	EN 10204, test report 2.2
Note : The definitions for 'LR Certificate', 'Manufacturer's Certificate validated by LR' and 'Manufacturer's Certificate' are provided in *Ch 1, 3 Certification of materials* of LR's *Rules for the Manufacture, Testing and Certification of Materials, July 2022*.	

12.8.3 The required documentation for the materials used in certified OPTS applications is provided in *Table 1.12.4 Material documentation for certified applications*. *See Ch 1, 1.7 Certification procedure*.

Table 1.12.4 Material documentation for certified applications

Type of structural member	Documentation
Critical structural component	'Manufacturer's Certificate' (equivalent to EN 10204, inspection certificate 3.1)
Primary structural component	'Manufacturer's Certificate' (equivalent to EN 10204, inspection certificate 3.1)
Secondary structural component	EN 10204, test report 2.2
Slewing ring and fasteners	'LR Certificate' or 'Manufacturer's Certificate validated by LR'
Note : The definitions for 'LR Certificate', 'Manufacturer's Certificate validated by LR' and 'Manufacturer's Certificate' are provided in *Ch 1, 3 Certification of materials* of LR's *Rules for the Manufacture, Testing and Certification of Materials, July 2022*.	

12.8.4 Any deviation from the above given documentation requirements shall be agreed with LR prior to any material being ordered for the actual project.

■ *Section 13*
Testing, marking and surveys

13.1 Testing

13.1.1 The requirements of *Ch 12 Testing, Marking and Surveys* of the *Code for Lifting Appliances in a Marine Environment, July 2022* (as applicable) are to be complied with unless stated otherwise in the following.

13.1.2 Every OPTS is to be tested and thoroughly examined before being taken into use for the first time or after any subsequent alteration or repair which may affect the strength or safety of the system. Every OPTS is further to be subjected to periodical thorough examinations as indicated in *Ch 12, 3 Survey requirements* of the *Code for Lifting Appliances in a Marine Environment, July 2022* (as applicable).

13.1.3 The requirements for test weights and precautions to be observed during testing are given in *Ch 12, 1.1 General* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

13.1.4 The test procedure and test loads are to be submitted to the responsible LR plan appraisal office for approval.

13.1.5 Testing and examination shall be carried out in accordance with the requirements of this sub-Section and the agreed Inspection and Test Plan (ITP).

13.1.6 An overview of the initial and periodical overload test loads is provided in *Table 1.13.1 Test loads – Overview*. The detailed requirements are provided in the following paragraphs of *Ch 1, 13.1 Testing*.

13.1.7 For A-GU type systems (providing unrestricted access) the initial overload tests and subsequent periodical overload tests are to be carried out using the test loads as defined in the following:

(a) A-GU gangway integrity test

The test load shall be applied uniformly along the completely extended gangway with the test load per square metre defined as follows:

$$TL_{A-GU.a} = F_T \; UDL_P$$

where

$TL_{A-GU.a}$

F_T = 1,5 = test load factor

UDL_P = 360 kg/m^2

This integrity test is only required at the initial survey; the test may be carried out at the manufacturer's works and does not need to be repeated on board.

(b) A-GU system test

(i) For A-GU type systems which are not designed to carry personnel in the cantilevered position, the test load is to be applied uniformly along the completely extended gangway with the test load per square metre defined as follows:

$$TL_{A-GU.b.i\ 1} = \frac{\left(F_T - 1{,}25\right) W_{gw}}{L_{gw} B_{gw}}$$

where

$TL_{A\text{-}GU.b.i.I}$ = test load, in kg/m^2

F_T = 1,5 = test load factor

g = 9,81 kg/m^2

W_{gw} = total dead load of the gangway, in kg

L_{gw} = length of gangway from heel to tip, in m

B_{gw} = effective width of gangway (*see Ch 1, 1.10 Terms and definitions 1.10.9* for a definition of the effective width), in m

Alternatively, the test load may be applied at the gangway tip and is defined as follows:

$$TL_{A-GU.b.i.2} = \left(F_T - 1{,}25\right)\; W_{gw} \frac{1}{2}$$

where

$TL_{A\text{-}GU.b.i.2}$ = alternative test load, in kg

The designer/manufacturer needs to evaluate whether it can be ensured that the gangway cannot be used in the cantilevered position. If this cannot be ensured the system needs to be designed and tested as a cantilevered system as defined in *Ch 1, 13.1 Testing 13.1.7.(b).(i)*.

(ii) For A-GU type systems which are designed to carry personnel in the cantilevered position, the test loads are to be applied at the gangway tip and are defined as follows:

$$TL_{A-GU.b.ii\ 1} = W_{gw}\left(\frac{F_T - 1{,}25}{2}\right) + F_T \; UDL_p \; L_{gw} \; B_{gw} \; \frac{1}{2}$$

where

$TL_{A\text{-}GU.b.ii.1}$ = test load, in kg

Alternatively, the test loads may be applied uniformly along the completely extended gangway with the test load per square metre defined as follows:

$$TL_{A-GU.b.ii2} = \frac{\left(F_T - 1,25\right)W_{gw}}{L_{gw}B_{gw}} + F_T\ UDL_p\ L_{gw}\ B_{gw}\frac{1}{2}$$

where

$TL_{A\text{-}GU.b.ii.2}$ = alternative test load, in kg/m^2

If the test load $TL_{A\text{-}GU.b.ii.2}$ is chosen to be applied along the completely extended gangway, the test as defined in *Ch 1, 13.1 Testing 13.1.7.(a)* may be omitted.

The gangway shall be in the cantilevered position in both cases (i) and (ii) during the overload test.

Table 1.13.1 Test loads – Overview

Type of load test	OPTS designed to carry personnel in cantilevered position	A-GU (Access - Gangway Unrestricted) *see* Note 1	A-GR (Access - Gangway Restricted) *see* Note 1
Gangway integrity test (A-GU only)	---	$TL_{A\text{-}GU.a} = F_T UDL_P$ *see* Note 2	---

OPTS test	No	$TL_{\text{A-gu.b.i1}} = \frac{\left(F_{\text{T}} = 1,25\right) W_{\text{gw}}}{L_{\text{gw}} B_{\text{gw}}}$ *see* Note 2 or $TL_{\text{A-gu.b.i2}} = \left(F_{\text{T}} = 1,25\right) W_{\text{gw}} \frac{1}{2}$ *see* Note 3	---
	Yes	$TL_{\text{A-gu.b.ii1}} = W_{\text{gw}}\left(\frac{F_{\text{T}} = 1,25}{2}\right) + F_{\text{T}}\, UDL_{\text{P}}\ L_{\text{gw}} B_{\text{gw}} \frac{1}{2}$ *see* Note 4 or $TL_{\text{A-gu.b.ii2}} = \frac{\left(F_{\text{T}} = 1,25\right) W_{\text{gw}}}{L_{\text{gw}} B_{\text{gw}}} + F_{\text{T}} UDL_{\text{P}}$ *see* Note 5	$TL_{\text{A-GR}} = W_{\text{gw}}\left(\frac{F_{\text{T}} = 1}{2}\right) + F_{\text{T}} \max\begin{bmatrix} SWL_{\text{P}} + SWL_{C} \\ 120\text{kg} \end{bmatrix}$ *see* Note 4

Note 1:

Test load factor: F_T = 1,25 for A-GR systems and F_T = 1,5 for A-GU systems

Uniformly Distributed Load – Personnel: UDL_P = 360 kg/m^2

Total dead load of the gangway, in kg: W_{gw}

Length of gangway from heel to tip, in m: L_{gw}

Effective width of gangway, in m: B_{gw}:

Safe Working Load – Personnel, in kg: SWL_P

Safe Working Load – Cargo on Gangway, in kg: SWL_{CG}:

Note 2: The test load shall be applied uniformly along the completely extended gangway.

Note 3: Alternatively, the test load may be applied at the gangway tip.

Note 4: The test load shall be applied at the gangway tip.

Note 5: Alternatively, the test load may be applied uniformly along the completely extended gangway.

13.1.8 For A-GR type systems (providing restricted access) the initial overload test and subsequent periodical overload tests are to be carried out applying the overload test load as defined in the following at the gangway tip:

$$TL_{\text{A-GR}} = W_{\text{gw}}\left(\frac{F_{\text{T}} - 1}{2}\right) + F_{\text{T}} \max\begin{bmatrix} SWL_{\text{p}} + SWL_{CG} \\ 120\text{kg} \end{bmatrix}$$

where

$TL_{A\text{-}GR}$ = test load, in kg

F_T = 1,25 = test load factor

W_{gw} = total dead load of the gangway, in kg

SWL_P = safe working load, personnel, in kg

SWL_{CG} = safe working load, cargo on gangway, in kg

The gangway shall be in the cantilevered position during the overload test.

13.1.9 If the actual or design envelope mothership normal to deck accelerations a_z form a ratio $\frac{g + a_z}{g}$ beyond 1,25 the test load as defined in *Ch 1, 13.1 Testing 13.1.7* and *Ch 1, 13.1 Testing 13.1.8* shall be increased using a test load factor of $F_T = 1 + \frac{a_z}{g}$ instead of 1,25. *See Ch 1, 3.11 Mothership motions and accelerations* for further information concerning mothership accelerations enabling the calculation of the test load factor.

13.1.10 Overload test loads deviating from the above will be specially considered.

13.1.11 In cases where the OPTS is intended to be used as an offshore and/or cargo handling crane, the testing requirements of *Ch 12, 1.6 Cranes and ROV handling systems* of the *Code for Lifting Appliances in a Marine Environment, July 2022* are additionally to be complied with.

13.1.12 During overload testing of the OPTS all its possible operating motions (e.g. slewing, telescoping) are to be carried out at low speed. The load test shall extend over all operational modes and configurations of the system. Any motion compensation system (MCS) is only to be engaged during overload testing in case the MCS of the OPTS has been designed to withstand the test loads as indicated in *Ch 1, 13.1 Testing 13.1.7* and *Ch 1, 13.1 Testing 13.1.8* in order to avoid overloading the MCS while being tested. The application duration of the test load shall be twice as long as the time required to move the OPTS from its stowage position to the target structure (considering a fully completed landing operation). Alternative durations of the application of test loads will be specially considered. The overload testing needs to be carried out on board the mothership. The overall displacement of the OPTS due to the applied overload shall be measured at the gangway tip and shall be less than the displacement limits as defined in *Table 1.5.1 Displacements limits*.

13.1.13 The OPTS is further to be tested with its SWL_P and/or UDL_P and SWL_{CG} being applied under all design working conditions at maximum related design speeds and with any motion compensation system activated and also de-activated. Both passive and active compensation modes (if any) shall be tested.

13.1.14 The OPTS shall be subjected to a full functional testing regime for normal operation during the initial survey (*see Ch 1, 13.3 Initial survey of new installations*), covering the following items as a minimum:

(a) electrical systems (including failure testing according to an approved test schedule derived from the FMEA);
(b) control systems (including failure testing according to an approved test schedule derived from the FMEA);
(c) communication systems;
(d) safety systems;
(e) limit switches;
(f) monitoring systems (if applicable);
(g) landing arrangements and systems; and
(h) slewing, telescoping and luffing arrangements and systems.

13.1.15 The OPTS shall be subjected to a full functional testing regime for emergency events during the initial survey (*see Ch 1, 13.3 Initial survey of new installations*), covering the following items as a minimum:

(a) overload protection systems;
(b) alarm systems;
(c) emergency disconnection (lift-off) systems;
(d) emergency retraction/disconnection systems;
(e) emergency systems;
(f) redundant and redundancy systems and arrangements; and
(g) emergency stop.

13.1.16 The functional test during the initial survey (*see Ch 1, 13.3 Initial survey of new installations*) shall extend to cover the motion compensation system either by:

(a) Testing by simulation, under the following conditions:
    (i) The motion compensation system may be tested by factory-based simulation, if it can be demonstrated that the simulation will not fall short of the dynamic loading and behaviour of the OPTS supporting mothership.
    (ii) The whole range and location of possible loads (UDL_P, SWL_P, SWL_{CG}) shall be taken into consideration in the simulation.
    (iii) It shall further be demonstrated that the motion compensation performance can also be properly tested.

(iv) The system shall be tested taking account of the maximum significant wave height the OPTS is required to perform under.

(b) Testing in open sea conditions:

(i) The motion compensation system may be tested in open sea conditions.

(ii) The whole range and location of possible loads (UDL_P, SWL_P, SWL_{CG}) shall be taken into consideration in the open sea testing.

(iii) The system shall be tested taking account of the maximum significant wave height the OPTS is required to perform under.

The test results are required to be recorded and documented. Alternative testing methods will be specially considered.

13.1.17 Load testing (including any SWL_P and/or UDL_P and SWL_{CG} tests) and functional testing shall be carried out without persons on the OPTS and/or gangway.

13.1.18 No persons shall be in the hazardous zone around the OPTS which will be affected by a failure of the OPTS during the load and functional testing.

13.1.19 After functional, SWL_P and/or UDL_P and SWL_{CG} (as applicable) and overload testing, the OPTS is to be thoroughly examined for deformations or other defects.

13.1.20 The load testing of the OPTS is to be repeated in the following circumstances using the approved test loads and procedures as defined in the above:

(a) Following any structural repair, alteration or re-erection of the appliances;

(b) at every fifth Annual Thorough Examination; and

(c) in accordance with the requirements of the National Administration.

13.1.21 The testing requirements for machinery items are as follows:

(a) Hydraulic cylinders: *See Ch 9, 5.9 Testing* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

(b) Winches: *See Ch 9, 4.2 Cranes and winches used for handling of personnel* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

(c) Pressure vessels: *See Pt 5, Ch 11, 10 Hydraulic tests* of the *Rules and Regulations for the Classification of Ships, July 2022*.

(d) Other items of machinery: Special consideration.

13.2 Marking

13.2.1 The requirements of *Ch 12, 2 Marking* of the *Code for Lifting Appliances in a Marine Environment, July 2022* are to be complied with unless stated otherwise in the following.

13.2.2 Each OPTS is to be clearly and permanently marked at the Operator's control station with a minimum of the following information:

(a) designer/manufacturer;

(b) product name;

(c) SWL_P and/or UDL_P and SWL_{CG}, ideally with a pictogram showing the location of application of the operational loads;

(d) access type (unrestricted/uncontrolled or restricted/controlled);

(e) maximum number of persons on the waiting platform (if any);

(f) maximum number of persons simultaneously allowed anywhere on the gangway (for restricted access);

(g) any restrictions or limitations of safe operation;

(h) minimum and maximum operational design luffing/inclination angles;

(i) minimum and maximum length considering the telescopic extension;

(j) stowage configuration and arrangement;

(k) manufacturing date;

(l) an identification mark to enable the system to be readily related to its appropriate test and certification or classification certificate; and

(m) with the mark of the Surveyor who witnessed the load and functional testing.

13.2.3 Limits of telescopic, slewing, luffing motion are to be marked on the OPTS structure (e.g. maximum and minimum gangway length, range of gangway inclination, etc.).

13.2.4 Each OPTS shall be clearly and permanently marked with at least the following information at the waiting area and on each end of the gangway:

(a) maximum number of persons on the waiting platform (if any);
(b) maximum number of persons simultaneously allowed anywhere on the gangway (for restricted access);
(c) any restrictions or limitations of safe operation;
(d) emergency procedures;
(e) alarms; and
(f) access limitations.

13.2.5 The marking language shall preferably be the English language. Alternatively, and depending on the requirements of the Flag or Coastal State Authorities, the language may, in addition, be that of the mothership's crew.

13.2.6 Any interface areas between moving parts shall be marked with a warning pattern in black and reflecting yellow.

13.2.7 If the OPTS is also used as a conventional offshore crane the marking requirements are to be in compliance with *Ch 12, 2 Marking* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

13.2.8 The OPTS parts, components, machinery items, shall be marked with visual danger signs in accordance with a recognised National or International Standard (e.g. EN 842 *Safety of machinery – Visual danger signals – General requirements, design and testing* or ISO 7010 *Graphical symbols – Safety colours and safety signs – Registered safety signs* as considered appropriate), as applicable.

13.3 Initial survey of new installations

13.3.1 The requirements of *Ch 12, 3.2 Initial Survey of new installations* of the *Code for Lifting Appliances in a Marine Environment, July 2022* are to be complied with unless stated otherwise in the following.

13.3.2 The requirements for fabrication and NDE are specified in *Ch 1, 12.6 Fabrication*.

13.3.3 The definition of critical, primary and secondary welds as given in *Ch 12 Testing, Marking and Surveys*, *Table 12.3.1 Minimum requirements for NDE* of the *Code for Lifting Appliances in a Marine Environment, July 2022* are redefined as follows for the application in an OPTS:

(a) **Critical welds**

are defined as welds where the failure of which may or will result in harm to persons using the OPTS or in the partial or complete loss of the OPTS, e.g. foundation/deck welds, slewing bearing/pedestal welds, base frame welds, main gangway structural welds, walkway support structural welds, waiting platform support structural welds, etc.

(b) **Primary welds**

are defined as welds directly applicable to floorings, ladders, walkways, waiting platforms, handrails, suspended baskets, personnel containments, etc.

(c) **Secondary welds**

are defined as non-critical and non-primary load-path member welds (as defined under (a) and (b)) and/or which are not involved in the prevention of harm to persons using the OPTS, e.g. service fittings (e.g. electrical, lighting), maintenance equipment, etc.

13.3.4 If the OPTS includes a slewing bearing in its design, initial bearing clearances shall be recorded by means of a rocking test after the initial proof load test. The rocking test shall be repeated annually in accordance with the slewing bearing manufacturer's recommendations. Acceptable tolerances shall be as per slewing bearing manufacturer's recommendations.

13.3.5 The control system shall be subjected to failure testing according to an approved test schedule derived from an approved FMECA.

13.4 Initial Survey of existing installations

13.4.1 The requirements of *Ch 12, 3.3 Initial Survey of existing installations* of the *Code for Lifting Appliances in a Marine Environment, July 2022* are to be complied with as applicable.

13.4.2 The plan appraisal is to be carried out as per the principles outlined in this document, in addition to the requirements of the *Code for Lifting Appliances in a Marine Environment, July 2022* as applicable to the OPTS.

13.5 Periodical thorough examinations

13.5.1 The requirements of *Ch 12, 3.4 Periodical Thorough Examinations* of the *Code for Lifting Appliances in a Marine Environment, July 2022* are to be complied with unless stated otherwise in the following.

13.5.2 For an OPTS the limits of wear down and corrosion are to be taken as follows:

(a) structural members below 10 mm thickness: 5 per cent;
(b) pins and axles below 100 mm diameter: 1 per cent; and
(c) any other diameter below 100 mm: 3 per cent.

For all other cases, the *Ch 12 Testing, Marking and Surveys*, *Table 12.3.4 Limits of weardown and corrosion* of the *Code for Lifting Appliances in a Marine Environment, July 2022* applies.

13.5.3 The interval for the thorough examination required for the OPTS and all associated gear and machinery engaged in personnel transfer operations is six months.

13.5.4 The periodical thorough examination of the electrical arrangements shall be carried out at the following intervals:

(a) annual visual inspection of cabling and equipment;
(b) annual examination of the earthing arrangements;
(c) annual visual examination of motors;
(d) five-yearly insulation tests of cabling and motors; and
(e) five-yearly testing of main circuit breakers (power supply).

13.5.5 The periodical thorough examination of the control arrangements shall be carried out at the following intervals:

(a) annual simulation testing of highly critical failures (as identified in the FMECA);
(b) five-yearly testing of the approved test schedule derived from the approved FMECA;
(c) five-yearly testing of safety systems (e.g. emergency stop);
(d) five-yearly testing of alarms;
(e) five-yearly testing of sensors related to operational limits; and
(f) five-yearly overload testing of the OPTS.

13.5.6 The detailed requirements for the thorough examination of the OPTS and associated loose gear are given in *Table 1.13.2 6-Monthly thorough examination of OPTS*.

Table 1.13.2 6-Monthly thorough examination of OPTS

Item	Survey
0. General	(a) The following requirements for the 6-monthly thorough examination of the OPTS shall be applied as applicable and as far as possible depending on the actual design of the OPTS. (b) If the design is novel or deviating from the requirements in this Code the scope of the thorough examination might need to be extended to cover the essential items of the actual OPTS. (c) The thorough examination shall take into account designer's/ manufacturer's maintenance and inspection instructions and recommendations.

1. Certification	(a) Check that certification issued by a competent body, exists for the OPTS to be examined. (b) Check the Register and/or the OPTS initial and periodical thorough examination documentation for any outstanding endorsements, recurring problems, down-ratings, etc. If there is no evidence that the OPTS has ever been certified, the thorough examination is to be declined and LR's certification services for existing OPTS may be offered. (c) Check the Register for any repairs or modifications. (d) Check the maintenance records.
2. Arrangements	Check reeving arrangement are as shown in Rigging Plan or designer's/manufacturer's manual. Check that the arrangement of hydraulic cylinders (if applicable) is as shown on the reeving diagram or appropriate plans.
3. Fixed sheaves, axle pins and housings	(a) Determine that the sheaves are free from cracks. The extent of the examination is to be such that a reliable judgement can be made. Depending on access, it may be necessary to dismantle the item. (b) Survey rope groove for scoring or uneven wear. (c) Check that lubrication arrangements are in working order. (d) Check security (keep plates, cotter pins, etc.) of fixed axle pins. (e) Check for free rotation of sheave on axle pin. (f) Check for excessive wear of axle pin and sheave bush. (g) Check condition of housing and separation plates and for signs of ovality in the pin holes.
4. Gangway heel pins and other pins in the main load-path	(a) Check lubrication for detrimental wear. (b) Check security (keep plates, cotter pins, castle nuts, etc.) of heel pins.

5. Slewing rings for OPTS	(a) Listen to the bearing during slewing motion for any untoward noises. Also note the age of the bearing or its operational hours (if possible) and check against guidance in designer's/manufacturer's maintenance manual. Older bearings will be more prone to problems. (b) Check any maintenance records for evidence of regular routine maintenance. (c) Check condition and tightness (using a method recommended by the manufacturer) of inner and outer bearing bolts, removing any protective caps if fitted. Sample bolts may be removed at the discretion of the Surveyor to check for the possibility of stress corrosion cracking. (d) Review the results of the latest rocking test measurements and grease sample analysis carried out in accordance with the designer's/manufacturer's recommendations and check the recommended limits for either wear or metallic particle content are not being exceeded. This will give an indication of the wear in the bearing. These tests are usually carried out annually. (e) Check the effectiveness of lubrication of the bearing. (f) Additional inspections are to be carried out where these are specified by the OPTS or slew ring manufacturer. (g) In case the OPTS is also designed and used as a conventional offshore crane the requirements of *Ch 12 Testing, Marking and Surveys*, *Table 12.3.6 Annual Thorough Examination of cranes (incuding derrick cranes) and launch and recovery systems for diving operations*, clause 6 of the *Code for Lifting Appliances in a Marine Environment, July 2022* are required to be complied with. (h) Any requirements of National Authority (i.e. Flag State) and/or Coastal State Authorities are required to be complied with.
6. Wire ropes	(a) Confirm that appropriate wire ropes certificates are on board (LA.4 or equivalent). (b) Check the general condition of ropes by examining as much of their length as is possible. (c) Check for broken or worn wires. Check for any signs of internal and external corrosion. Check for changes in rope diameter. Check for signs of damage and deformation (e.g. kinks, birdcaging, etc.), or of thermal damage. In general, the rope is to be replaced immediately, if any of the discard criteria in ISO 4309 *Cranes – Wire ropes – Care and maintenance, inspection and discard* are exceeded. (d) Inspect rope terminations, splices, end fittings, etc. with particular attention to broken wires at ferrule connections. Any serving on splices is to be removed for the examination. (e) Liverpool splices are to be rejected on any rope where the ends are not secured against rotation. (f) Before re-rigging ensure that the wire rope has been lubricated.

7. Structure and general	(a) Check structural bolts for tightness. Where bolts have been replaced, they are to be of the same type, size and quality as previously fitted. (b) Check pedestal and foundation bolts for signs of corrosion and flange distortion. (c) Check main welds for cracks. Initially by visual examination but NDE can be used at the Surveyor's discretion. (d) Check welds between pedestal/foundation and the mothership. Initially by visual examination but NDE can be used at the Surveyor's discretion. (e) Inspect the structure for condition of coating. Inspect the structure for corrosion, removing paint and carrying out hammer tests as necessary. If considered necessary, the thickness of structural items is to be checked by ultrasonic testing or other suitable methods that do not affect the material or condition of the structure. (f) Check base frame, gangway, walkways, guard rails, handrails, stanchions, supporting pedestal (or foundation), for any signs of damages, local indentations, buckling, cracks or unfairness. Particular attention is to be given to connections of chords and lattices, hydraulic cylinder connections, sheave housing attachments, gangway tip, and other areas where there is significant load input. (g) Check connection between gangway, guard rails, handrails and stanchions. (h) Check connection of flooring elements with the supporting structure. Flooring elements and other parts in way of the walking area shall not pose a tripping hazard. (i) Check whether the gaps between moving parts are not excessive posing a crushing hazard. (j) Check sea-fastening/stowage arrangements (if applicable). (k) Check other items reflecting the intension of the above list or similar to the above consideration the actual design of the OPTS.
8. Shackles, links, rings, etc.	(a) Check loose gear items, can be identified against appropriate certificates (LA.3 or equivalent). (b) Examine under proper conditions and check for cracks, deformation, wear, wastage or other defects. Items are to be free from paint, grease, scale, etc. (c) Confirm that the material is recorded on the test certificate. The certificate should distinguish between mild steel, higher tensile steel and alloy steel. (d) Deformed shackles or shackle pins shall be replaced. (e) If the shackle pin is renewed, the whole shackle is to be re-tested and certified.

9. Chains	(a) Confirm appropriate chain certificates on board (LA.3 or equivalent). (b) The chain is to be taken to a suitably equipped workshop for examination and examined after removal of paint, grease, scale, etc. and wire brushing. (c) Check for deformation, wear or other defects. If links require renewal, the chain is to be suitably heat treated and re-tested. Replacement links are to be of equivalent material and strength to the original. (d) Confirm that material is recorded on test certificate. The certificate should distinguish between mild steel, higher tensile steel and alloy steel.
10. Rope drums	(a) At least three turns of wire rope are to remain on the drum. (b) Check the effectiveness of wire rope anchorages. (c) Check drum for cracks and for defects liable to damage the rope. (d) Check the effective working of any fleeting device fitted. (e) Check drum flanges for bending or distortion. This is particularly appropriate for multi-layer spooling drums.
11. Hydraulic arrangements	(a) Check hydraulic hoses, pipes, couplings, actuators, filters, valves, measuring devices, control blocks and other hydraulic components for leakage and/or damage. (b) Check hydraulic pumps and motors for leakage and/or damage. (c) Check hydraulic accumulators for leakage, deformation and/or other damage. (d) Check pre-fill pressure of the hydrogen bottles, as applicable. (e) Check for correct oil levels.
12. Hydraulic cylinders, winches, etc. and attachments	(a) Check condition of machinery systems. (b) Check for leaks and condition of hydraulic pipes and couplings. (c) Check piston rod for scoring and signs of deformation. (d) Check end pivot pins and bearings for any excessive wear and deformation, and the security of the pins. (e) Check that mounting brackets are free from deformation, cracks or damage. (f) Check safety systems, such as limit switches and slack rope detection systems. (g) Check fasteners, pins, gear boxes, shafts, bearings, lubrication, etc. (h) Check condition of brake (e.g. pads, brake linings).

13. Electrical and control arrangements	(a) Check the Operator station and other operating arrangements for suitable condition. (b) Check operation of audible and visual warnings. (c) Check electrical arrangements in general and cabling for state and secure connection. (d) Check effectiveness of limit switches. (e) Check condition of electric motors. (f) Check OPTS for safe operational behaviour as required by the instructions for use. (g) Conduct earthing test, e.g. megger test.
14. Re-testing	(a) Loose gear is to be proof tested if repairs have been carried out which affect its strength or if certificates are not available. (b) Re-testing of the OPTS is necessary at five-yearly intervals and after repairs or modifications have been carried out affecting the strength or otherwise as required by the Surveyors. The test is to demonstrate satisfactory operation, efficiency of overload and weight load indicators, effectiveness of limit switches, etc. (c) It is essential that the OPTS is operated at each thorough examination to check gangway luffing, slewing, telescoping and other motions as applicable, and the correct operation of associated limit switches for such motions. In case an overload protection system is installed such system shall also be checked.

13.6 Deferment and range of surveys

13.6.1 The requirements for deferment of surveys are given in *Ch 12, 3.5 Deferment of surveys* of the *Code for Lifting Appliances in a Marine Environment, July 2022* and are to be complied with as applicable.

13.6.2 If permitted by the Administration (Flag State) the six-monthly thorough examination date can be held within a time frame of ±3 months.

13.7 Damage surveys

13.7.1 The requirements of *Ch 12, 3.6 Damage surveys* of the *Code for Lifting Appliances in a Marine Environment, July 2022* are to be complied with as applicable.

13.8 Design changes or modifications of existing OPTS

13.8.1 Design changes or modifications of an already certified or classed OPTS are required to be submitted for appraisal in order to maintain the validity of the certification or classification.

13.8.2 The application of the design changes or modifications are in principle to be carried out in compliance with *Ch 1, 13.3 Initial survey of new installations*. The extent of the survey is to be agreed with the attending Surveyor.

13.9 Classification surveys

13.9.1 In addition to the requirements of this Code, the requirements of *Ch 12, 3.7 Classification surveys* of the *Code for Lifting Appliances in a Marine Environment, July 2022* are to be complied with as applicable.

13.10 Thorough examinations after emergency situations

13.10.1 Emergency situations are to be clearly defined in the instructions for use and are to be derived from the risk assessment. Emergency situations may result in loads which are beyond the certified SWL_P and/or UDL_P or other applicable *SWL* depending on the design and associated intended use.

13.10.2 In case the OPTS has experienced an emergency situation a thorough examination is to be carried out in order to ensure that there are no damages or defects and that it is safe to resume normal operation.

13.11 Non-permanently installed OPTS

13.11.1 OPTS which are not permanently installed on the mothership are required to be treated as new installations for the project phase where the OPTS is installed on the new mothership. All on-board testing related to the integration of the OPTS with the new mothership (as required by this Code, including load testing) are to be repeated.

13.12 Maintenance requirements

13.12.1 The designer/manufacturer shall provide a detailed maintenance manual covering all components, parts and aspects of the OPTS.

13.12.2 The OPTS and their components (including associated winches, hydraulic cylinders, loose gear, ropes, etc.) shall be properly maintained as per the requirements of the designer/manufacturer as stated in the maintenance manual at required intervals.

13.12.3 Every OPTS is to be visually inspected once a week by the crew or Operator to ensure they are at all times ready for immediate use.

13.12.4 A record of maintenance should be kept for each OPTS.

Section 14
Documentation

14.1 General

14.1.1 This Section defines the documentation that will be issued by LR for OPTS and its components.

14.1.2 The procedure and requirements for the issue of certification by LR are specified in *Ch 1, 1.2 Certification* of the *Code for Lifting Appliances in a Marine Environment, July 2022* unless stated otherwise in the following.

14.1.3 Where the OPTS is required to be classed, the requirements of *Ch 1, 1.3 Classification* of the *Code for Lifting Appliances in a Marine Environment, July 2022* are to be complied with unless stated otherwise in the following.

14.2 Certificates for certification

14.2.1 Certificates are to be prepared and endorsed by LR, and are to be kept available, showing that:

(a) Satisfactory tests have been carried out on each OPTS as rigged (including any associated items of loose gear) for its intended mode of operation.
(b) The required Periodical Surveys of each OPTS have been carried out.

14.2.2 General inspection certificates are issued to document the survey during manufacturing and survey of the completed OPTS. Reference is made to process steps 4 and 5 as defined in *Ch 13 Documentation*, *Table 13.2.1 Minimum requirements for the certification of lifting appliances* or *Table 13.3.1 Minimum requirements for the classification of lifting appliances* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

14.2.3 For certification of OPTS the following certificates will be issued following satisfactory completion of all the conditions required for the issue of certification by LR. *See Ch 13 Documentation*, *Table 13.1.1 Certificates for certification* of the *Code for Lifting Appliances in a Marine Environment, July 2022*:

(a) LA.1 (Form 1365) – Register of Ship's Lifting Appliances and Cargo Handling Gear;
(b) LA.2OPTS (Form 1386) – Certificate of Test and Thorough Examination of Offshore Personnel Transfer Systems;
(c) LA.3 (Form 1382) – Certificate of Test and Thorough Examination of Loose Gear before being taken into use, and of such gear after it has been altered or required (as applicable and required);
(d) LA.4 (Form 1383) – Certificate of Test and Thorough Examination of Wire Rope, before being taken into use (as applicable and required); and
(e) LA.5 (Form 1384) – Certificate of Test and Thorough Examination of Fibre Rope, before being taken into use (as applicable and appropriate).

Refer to process steps 3, 6 and 7 as defined in *Ch 13 Documentation*, *Table 13.2.1 Minimum requirements for the certification of lifting appliances* or *Table 13.3.1 Minimum requirements for the classification of lifting appliances* of the *Code for Lifting Appliances in a Marine Environment, July 2022*.

14.2.4 The certification certificate for the OPTS will be the LA.2OPTS similar to the LA.2 as defined in *Ch 13 Documentation*, *Table 13.1.1 Certificates for certification* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. The LA.2OPTS may be attached to the LA.1. In addition to the LA.1 and LA.2OPTS all certificates given in *Ch 13 Documentation*, *Table 13.1.1 Certificates for certification* of the *Code for Lifting Appliances in a Marine Environment, July 2022* may be issued (as applicable) for certification apart from the LA.2U and the 'Certificate of Classification'.

14.3 Certificates for classification

14.3.1 Where the lifting appliance is to be classed, certificates of classification and subsequent certificates of class maintenance will be issued on compliance with the appropriate requirements. The certificates are listed in *Ch 13 Documentation*, *Table 13.1.1 Certificates for certification* of the *Code for Lifting Appliances in a Marine Environment, July 2022*. The LA.2OPTS will be issued instead of the LA.2.

14.3.2 The LA.1 is to have the appropriate class notation written on the front cover.

14.4 Certification procedure

14.4.1 The principal certification procedures concerning:

(a) initial surveys;
(b) periodical surveys;
(c) damage surveys;
(d) deferment of survey; and
(e) other surveys.

are defined in *Ch 13, 2 Certification procedure* of the *Code for Lifting Appliances in a Marine Environment, July 2022* as applicable and if not otherwise defined in this Code.

14.5 Classification procedure

14.5.1 The principal classification procedure is defined in *Ch 13, 3 Classification procedure* of the *Code for Lifting Appliances in a Marine Environment, July 2022* as applicable and if not otherwise defined in this Code.

Contents

CHAPTER 1 OFFSHORE PERSONNEL TRANSFER SYSTEMS

CHAPTER 2 ANNEX RECOMMENDATIONS FOR SAFE OPERATION OF THE OPTS

SECTION 1 GENERAL

SECTION 2 EXCHANGE OF INFORMATION

SECTION 3 OPERATIONAL ASPECTS

SECTION 4 ACTIVITIES PRIOR TO USE

SECTION 5 MISCELLANEOUS ASPECTS

Annex Recommendations for Safe Operation of the OPTS

Section
1 **General**
2 **Exchange of information**
3 **Operational aspects**
4 **Activities prior to use**
5 **Miscellaneous aspects**

Section 1
General

1.1 Intention

1.1.1 These recommendations are intended to support the Owners/Operators in the safe operation of OPTS.

1.2 Scope

1.2.1 The recommendations in this Annex are not part of the certification or classification scope.

Section 2
Exchange of information

2.1 Exchange of information (Owner/Operator to manufacturer)

2.1.1 This Section defines the recommended information which should be made available to the manufacturer (or designer) by the Owner/Operator.

2.1.2 Environmental and operational conditions:

(a) area classification (e.g. hazardous area);
(b) environmental conditions and in particular:
  (i) operational significant wave heights (as applicable);
  (ii) out-of-service significant wave heights (as applicable);
  (iii) wind speeds;
  (iv) lowest temperature of operation as defined in *Ch 4, 2.25 Materials 2.25.3* of the *Code for Lifting Appliances in a Marine Environment, July 2022*;
(c) operational mothership accelerations and inclinations (which may be associated with the significant wave heights and location on the mothership);
(d) support conditions of the OPTS on board the mothership;
(e) interface drawing of the mothership in the area and at the location where the OPTS is installed;
(f) geometrical limitations as required by the mothership;
(g) limitations of forces and moments as required by the mothership;
(h) details of emergency procedures affecting the OPTS operations (particularly in case the OPTS is engaged in evacuation procedures);
(i) communication requirements between:
  (i) Operator and mothership;
  (ii) Operator and target unit;
(j) stowage arrangements, including vessel accelerations and inclinations;
(k) number of persons to be transferred at the same time;

(l) details required to conduct safe transfer operations (e.g. one-way or two-way flow of personnel);
(m) operational target unit accelerations as applicable (associated with the wave heights) and relative to mothership deck the nominal elevation of target structure which the OPTS will be touching on or is connecting to; and
(n) planned duty cycle (expected number of operational cycles and life time of equipment).

2.2 Exchange of information (manufacturer to Owner/Operator)

2.2.1 This Section defines the recommended information which should be made available to the Owner/Operator by the manufacturer (or designer).

2.2.2 Detailed instructions for use including the following information should be provided:

(a) OPTS system type and access type as defined in *Ch 1, 2 Offshore Personnel Transfer System types*;
(b) any special features/designs as defined in *Ch 1, 2 Offshore Personnel Transfer System types*;
(c) connection and disconnection types as defined in *Ch 1, 2 Offshore Personnel Transfer System types* and *Ch 1, 9.7 Disconnection systems*;
(d) interface requirements between OPTS and mothership and OPTS and target unit (e.g. structural, mechanical, electrical, hydraulic, etc.);
(e) the OPTS operational and environmental limitations and parameters including the significant wave height and wind speed, including any limiting mothership accelerations and inclinations associated with operational, emergency and stowage conditions;
(f) the OPTS capacity for personnel (and load transfer duties, as applicable) including information regarding any restrictions in operational procedure during personnel transfer;
(g) OPTS configurations and geometrical extension;
(h) qualification, training and duties of the Operator (*see Ch 1, 1.12 Information to be submitted*);
(i) service life;
(j) design operating temperature;
(k) station keeping performance (e.g. system capability plot) of the Dynamic Positioning (DP) System or other station keeping systems (all as applicable);
(l) plan of the interface area specifying the points designed for sea fastening on mothership deck. If required, also the height of additional foundation on deck due to OPTS operational limits in gangway accessing the target unit/structure;
(m) maximum overturning moment, the torque and side forces/moments with corresponding axial and radial loads to be taken by the OPTS supporting structure;
(n) details of required stowage arrangements;
(o) degraded modes of operation as a result of an identified failure (if applicable);
(p) emergency procedures; and
(q) instructions for use and maintenance manuals.

■ *Section 3*
Operational aspects

3.1 Transfer operations

3.1.1 The transfer or handling of personnel and the handling of cargo should not be conducted simultaneously. An exception to this is the use of cargo baskets or trolleys during transfer of personnel operations via the gangway. The cargo baskets or trolleys should be secured against uncontrolled movements on the gangway and elsewhere on the OPTS as applicable.

3.1.2 Dropped or moving objects posing a hazard to the transferring personnel, the Operator and any part of the OPTS shall be considered during the operation of the OPTS. If cargo operations close to the OPTS or suspended loads being moved over the OPTS cannot be avoided, it shall be ensured that personnel transfer operations are not conducted, and personnel are not on or near the OPTS at those times of operation.

3.2 Safety equipment

3.2.1 The Operator and all transferring personnel should wear a lifejacket, tracking device, safety boots, safety goggles and helmet throughout OPTS operations commencing.

3.2.2 A lifebuoy equipped with a self-igniting light and a buoyant lifeline should be available for immediate use in the vicinity of the OPTS when in use.

3.2.3 It is further recommended that, depending on the weather condition (e.g. cold climate and/or harsh weather), transferring personnel wear suitable PPE, such as survival suit, tracking device.

3.2.4 Signs reminding personnel to wear the required PPE should be fitted.

3.2.5 For A-GU type systems it is recommended that a safety net is used between the mothership and the target unit preventing persons from falling directly into the sea.

3.3 Observation during operation

3.3.1 The following aspects should be observed during the operation of the OPTS in order to ensure continued safe operation:

(a) approaching the operational limitations as defined in the instruction for use;
(b) change of environmental conditions and approaching environmental limitations (e.g. significant wave height, wind speed);
(c) application of correct consequences when approaching or exceeding operational and environmental limitations as required by the instructions for use;
(d) limitations of personnel simultaneously allowed on the gangway and/or the OPTS in general;
(e) behaviour of the personnel to be transferred;
(f) combined movements of various parts and components of the OPTS (e.g. slewing of gangway together with luffing or telescoping);
(g) potential collision of moving parts of the OPTS (i.e. gangway) with the environment;
(h) conditions to be fulfilled to initiate starting or stopping motions;
(i) conditions for emergency stop and the resulting consequences; and
(j) evaluation that the requirements for safe transfer are always kept throughout the operation as required by the instructions for use.

3.4 Operators and transferring personnel

3.4.1 The Operator should be qualified, trained and certified before operating the OPTS in accordance with the instructions from the manufacturer and/or requirements of the National Authority (i.e. Flag State) and/or Coastal State Authorities.

3.4.2 The transferring personnel should be properly instructed prior to any commencing transfer operation.

3.5 Environmental aspects

3.5.1 The maximum wind speed during any personnel transfer operations should be limited to 15 m/s. Higher wind speeds will be specially considered. Reference is to be made to *Ch 2, 4.1 Pre-use risk assessment* on operational aspects for the use of the OPTS in high winds.

3.5.2 Ice and snow should be removed from areas where personnel and/or the Operator have access to before and during operation of the OPTS and where such ice and snow will pose a hazard to personnel and/or Operator.

3.5.3 Signs reminding personnel to remove any accretion of ice and snow should be fitted.

■ *Section 4* Activities prior to use

4.1 Pre-use risk assessment

4.1.1 A risk assessment should be carried out prior to every use in relation to hazards associated with the following:

(a) suitability of environmental conditions (e.g. wind speeds, significant wave heights, snow, ice, visibility, currents, water temperature, lightning, etc.);
(b) suitability of SWLs or UDL for the intended operation(s);
(c) transfer of only the absolutely necessary personnel;
(d) duration and frequency of intended transfers;
(e) potential mothership inclinations (heel, trim);

(f) potential mothership motions (sway, surge, heave, roll, pitch, yaw);
(g) capability to control mothership and target unit movements (e.g. by means of dynamic positioning);
(h) suitable condition of the OPTS and associated and/or remote equipment, e.g.
    (i) state of OPTS in general and its components;
    (ii) status of indicating devices and warning messages signalling the state of the OPTS (e.g. wind speeds, state of hydraulic system, state of power supply, state of control system, etc.);
    (iii) correctly functioning indicators;
    (iv) correctly functioning control devices and system;
    (v) correctly functioning limiting devices and systems;
    (vi) correctly functioning protection devices and systems;
    (vii) maintenance status, documentation status, certification status, etc.);
(i) effects of green sea or similar;
(j) adequate lighting provided;
(k) all accessible areas free of slip and trip hazards;
(l) suitability of conditions on the mothership and target unit (e.g. sufficient space available);
(m) suitability and functioning of communication facilities;
(n) operational limitations of the OPTS and associated and/or remote equipment;
(o) operations taking place in parallel with the potential affecting the personnel transfer operation and its safety (e.g. crane operations);
(p) availability of life-saving equipment/appliances and equipment aiding personnel rescue (e.g. for man-overboard scenarios);
(q) personnel and Operator suitably trained;
(r) experience of personnel to be transferred;
(s) direct visual contact and communication between Operator and personnel to be transferred;
(t) direct visual contact and communication with mothership and target unit and structure;
(u) potential dropped objects and protection against dropped objects;
(v) required PPE provided;
(w) rescue of injured personnel;
(x) rescue/recovery of personnel falling from the OPTS; and
(y) consideration and establishment of necessary escape routes.

4.1.2 Any relevant findings of the design risk assessment concerning operation should be considered. For the methodology of the design risk assessment, *see Ch 1, 10 Risk assessment*.

4.2 Pre-use briefing

4.2.1 The pre-use risk assessment should be followed by a general and situation specific briefing of the transferring personnel and the Operator and should include the following:

(a) standard operating procedure for safe transfers;
(b) specific hazards and mitigation as a result of the pre-use risk assessment;
(c) behaviours and safety procedures in case of an emergency;
(d) observations, wishes and questions from the personnel to be transferred; and
(e) roles and communication.

4.3 Pre-use inspection

4.3.1 Before any personnel transfer operation commences, an inspection of the OPTS and associated gear/equipment/components is recommended prior to each consecutive use following stowage, in order to ensure that the system is in suitable condition as per the requirements of the designer's/manufacturer's instructions for use and maintenance. The results of the pre-use risk assessment should be applied in the pre-use inspection. The inspection/examination should be documented and made available if necessary.

4.3.2 For fully passive OPTS (e.g. systems bridging a 'Floatel' and an FPSO) or dual mode systems which are in passive mode for a long time (e.g. more than a day) the inspection should be carried out daily prior to each consecutive use. The inspection/examination should be documented and made available if necessary.

4.3.3 For systems which are fully actively compensated and/or need to be manoeuvred into position prior to (active or passive) use, it is recommended that the system functions are tested in a 'dry run' in an area above the mothership without personnel on the gangway and OPTS. This could mean to carry out all motions (e.g. slewing, luffing and telescoping) in order to verify that the arrangement functions correctly. During such operations no persons should be on the OPTS or in the hazardous zone around the OPTS.

Section 5
Miscellaneous aspects

5.1 Integration

5.1.1 Before the OPTS is installed on an actual mothership it should be ensured that the accelerations of the actual mothership are within the design load envelope.

5.2 Target structure

5.2.1 The target structure should be designed to provide sufficiently rigid structural support to safely accommodate the landing of the OPTS gangway tip or personnel containment and to enable safe transfer of personnel. The target area should be free from obstructions.

5.2.2 It should be ensured that the OPTS gangway tip or personnel containment is functionally and structurally compatible with the target structure.

5.2.3 The motion compensation performance and/or limitations of the OPTS may need to be compatible with the station keeping capability and performance (e.g. system capability plot) of the target unit (if installed). For the assessment of the compatibility the following should be considered:

(a) safe situation after the worst case single failure of the station keeping system/arrangement;
(b) positioning restrictions induced by the target unit; and
(c) compensation capability of the OPTS.

5.3 Stowage

5.3.1 The system should be properly stowed as soon as the in-service wind speed and/or the in-service design significant wave height are exceeded by more than 50 per cent (whichever comes first). The out-of-service wind speed should be applied for design purposes.

5.3.2 Properly stowed is defined so as to cover at least the following aspects:

(a) The gangway or personnel containment of the OPTS is in its designated stowage position.
(b) The machinery systems of the OPTS are disconnected from the power source and are secured.
(c) The stowage arrangements and facilities of the OPTS are all engaged and locked.

5.3.3 For full stowage and in-field-transit any telescopic components (e.g. gangway) should be retracted as far as possible.

5.3.4 Depending on the OPTS type and design it may be acceptable for in-field-transit that a less strict securing regime is applied. For example, it might be acceptable that the gangway is only supported by the luffing systems and the gangway slewing is arrested by drive brakes for in-field-transit cases. However, in such cases it should be ensured that proper weather window information is obtained in order to ensure that the design loads for the system are not exceeded and/or hazardous situations, such as uncontrolled gangway movements, are avoided in all cases.

Published by Lloyd's Register Group Limited
Registered office (Reg. no. 08126909)
71 Fenchurch Street, London, EC3M 4BS
United Kingdom